SCIENCE AND TECHNOLOGY POLICIES RESEARCH CENTER

TEKPOL Working Paper Series

11/01

# Patents from the Academe: A Methodology Research for the Analysis of University Patents and Preliminary Findings for Turkey


**Serkan Atmaca**
Science and Technology Policy Studies PhD student, Middle East Technical University, Ankara, Turkey



TEKPOL | Science and Technology Policies Research Center
Middle East Technical University
Ankara 06531 Turkey
http://www.stps.metu.edu.tr

**Science and Technology Policies Research Center**
**TEKPOL Working Paper Series**

# Patents from the Academe: A Methodology Research for the Analysis of University Patents and Preliminary Findings for Turkey

Serkan Atmaca
Science and Technology Policy Studies PhD student,
Middle East Technical University, Ankara, Turkey
atmaca.serkan@gmail.com

**Abstract.** University patenting has been drawing attention of researchers studying university-industry relations, technology transfer mechanisms, changing research motives of the academe and consequences on their scientific performance. This study aims to develop a methodology for comprehensive analysis of university patents as the milestone of commercialization process of scientific knowledge produced by the academe, and evaluates preliminary findings for Turkey. For this purpose, patent applications at the Turkish Patent Institute are analyzed and a relational database is designed for storing university and researcher (academic inventor) characteristics, as well as industrial classification information of patents. In addition, interviews are conducted with academics in inventors list of patent applications to gather qualitative information about research activities and "commercialization" of patents. Results indicate that university patenting in Turkey is extremely low in number and commercialization is at its early stages. However, the results are based on very limited information, and with the aim developing a methodology, this study is open for further improvement in information gathering, as well as consistency in analyses.

**Keywords:** University patents, academic patenting, academic inventors, commercialization of patents.

# 1. Introduction

For the last quarter of the century, university-industry relations, technology transfer topics have been gaining significance in national technology and innovation policies. Governments have been developing policy tools and introducing incentives to enhance conversion of scientific knowledge produced at the academe to innovation, commercialization of academic research, technology transfer and knowledge spillovers from universities to the industry. As a result of those policies, there has been an increase in patents granted to universities, as well as patents where academics are involved. With the establishment of technology transfer offices at universities, academic patenting has also gained acceleration.

Abovementioned pace in patents from the academe did not escape researchers' notice. Majority of research focused on the effects of academic involvement on scientific research performance of universities (Azoulay et al., 2009; Breschi et al., 2008; Caro, de Lucio, and Gracia, 2003; Geuna and Nesta, 2006; Gibbons et al., 1994; Griliches, 1990; Louis et al., 1989). Authors uttered their concerns about shifting of universities away from basic or fundamental research, decreasing productivity of academics and diminishing "quality" of research outputs. Consequently, literature on academic patenting got crowded with studies analyzing the basic research and publication performance of academe concentrating on applied research ending-up with patents.

There are fewer micro-level studies focusing on the quantitative analysis of patents, their distributions by universities and contents and academic inventors, characteristics of academic inventors and relation of patents with specialization of universities (Lissoni et al., 2008; Göktepe, 2008). There are also a few studies that analyze mechanisms of technology transfer at universities (Owen-Smith and Powell, 2001; Schmoch et al., 2003).

However, issues like commercialization of scientific knowledge, feedbacks of industry relations from universities aspect, effect of technoparks and researcher mobility on university/academic patenting and mechanisms behind the continuity of academic patents are not seen in the abovementioned studies. Moreover, they focused on "cross-sections" of university patenting, rather than taking the picture of entire process starting with the research idea, ending with licensing of the patent and making publications out of it.

For a thorough understanding of the nature of patents from the academe, motives behind applied research conducted by universities and their consequences in several aspects, such as technology transfer and knowledge spillovers towards the industry, a broader approach to the subject is needed. University / academic patents should be considered as a milestone – rather than a result – in “commercialization” process of scientific knowledge, also regarding their mutual effect on the industry (from technical change perspective), and on academia (from research point of view).

Based on the abovementioned approach, this study aims to construct an infrastructure of a comprehensive analysis method for the case of Turkey. Regarding the technology transfer and knowledge dissemination originating from the academe, university patenting process is analyzed in two phases, namely pre and post-patent. “Pre-patent” phase focuses on the research activities that end up with patent application. Reasons behind the initiation of research, like academic curiosity or demand from the industry, existence of cooperation among different institutions, disciplines or organizations, composition of academic inventors’ titles, gender and ages, outputs of research other than patents – such as theses and scientific publications, and relations with previous research or patents are all subject to this phase. “Post-patent” phase refers to the commercialization of scientific research, diffusion of academic knowledge through publications citing those patents and mobility of researchers, as well as their triggering effects on future patents.

In this context, both quantitative and qualitative data are gathered. Patent applications, patent classification and industry concordance tables, academic resumes are used as primary sources of quantitative information for profiling “academic inventors” and give clues on characteristics of universities / academics concentrating on industry-driven or applied research activities, as well as related industries where those activities accumulate. Although such information indicate skills and capabilities of the academe in acquiring commercializable results out of scientific knowledge, further research is needed to evaluate especially the post-patent phase. Therefore, interviews are held with academic inventors listed in the patent application forms. Data acquired via abovementioned methods are entered to a relational database (will be named as UNI-PAT that stands for university patents), which can be defined as a different version of KEINS database used by Lissoni et al. (2006), is developed. UNI-PAT database is designed to store both patent application data and information about licensing, and related publications.

This paper is organized as follows. After this brief introduction to the subject and objectives of the study, Section 1 reviews previous research on university/academic patents. In Section 2, terminology used in the study and throughout the paper is clarified. Scope of the study and its limitations are discussed in Section 3. After explaining the methodology and briefly mentioning first version of UNI-PAT database in Section 4, results of analysis and preliminary findings are presented in Section 5. Final section summarizes main findings and provides a checklist for further research.

## 2. Review of Previous Research on Patents from the Academe

Researchers have been showing an increasing interest in studying patents owned by universities (Azoulay et al., 2009; Breschi et al., 2007; Breschi et al., 2008; Caro et al., 2003; Geuna and Nesta, 2006; Gibbons et al., 1994; Griliches, 1990) and patents based on inventions made by academicians (Göktepe, 2006; Henderson et al., 1998; Van Pottelsberghe and Saragossi, 2003; Jaffe, 1989). Focus of analyses vary in a wide range, such as relations between university patents and scientific research, effects of patenting by academe on diffusion of knowledge, university-industry relations, mechanisms of technology transfer and characteristics of academic inventors.

With the surge in university / academic patents due to incentives and reward mechanisms, more academicians started to spend considerable amount of their time and effort on research areas where they can grant more patents (Azoulay et al., 2009). Increasing popularity of applied and development research in universities brought concerns for the "quality" and "content" of scientific research (Azoulay et al., 2009; Breschi et al., 2008; Caro et al., 2003; Geuna and Nesta, 2006; Gibbons et al., 1994; Griliches, 1990; Louis et al., 1989) and productivity of researchers. Lee (1996) presents empirical evidence for shifting of researchers from basic to applied research and draws attention to the detrimental effect of this change on fundamental research. On the other hand, Thursby and Thursby (2002) show that there is no shifting away from fundamental research, but a cut from leisure time instead. According to their theoretical model, the time faculty members devote to research is higher in their early career, regardless of getting any incentive or reward for applied research. Incentives increase the ratio of basic research to basic research, but they compensate the time spent by cutting back their leisure activities. Geuna (1999), on the other hand, states that – in some cases – it becomes university policy to conduct more applied research which causes a divergence among universities. Certain universities exploit the “benefits” of industry driven research with substantial increase in funds and concentrate on “commercial” activities including patents, whereas others start to lose financial resources even for basic research.

Stephan et al. (2007), Azoulay et al. (2009), Geuna and Nesta (2006), and Breschi et al. (2008) present empirical evidence showing positive relation between university / academic patenting and scientific publications. Breschi et al. (2007) also mention bidirectional effect between publications and patents based on statistical analysis, showing that scientifically more productive researchers tend to have more patents, and more patenting triggers more publications. They also find out that positive relation between patents and publications varies among scientific fields, being stronger in pharmacology, electronics, chemical engineering and biology.

Related with the “scientific productivity” issue mentioned above, Pavitt (1998) studies university patents from a different perspective. After his survey on previous analyses of patent datasets, he asserts that studies about the contribution of academic scientific research on diffusion of knowledge and technological change should be enriched by conducting comprehensive research on citations in patent applications to academic publications.

As an example for university-industry relations, Owen-Smith and Powell (2001) conducted a field study to determine the success rate of commercializing “high-quality” basic research at US universities. They came up with the conclusion that it varies a lot across institutions depending on the existence and skills of technology transfer offices (TTO). TTOs are the bridges between university and industry. They collect research data, identify “patentable” results, conduct patenting process and make arrangements with the industry as the final stage of commercialization, such as licensing. However, mediating role of TTOs in university-industry relations may be misleading when it comes to figure out university-industry relations by analyzing patent data only. TTOs try to give as many licenses as possible to strengthen research funds of the university. Although it speeds up knowledge diffusion from academe to industry, it is not possible to acquire such information from patent data (Van Pottelsberghe and Saragossi, 2003). On the other hand, TTOs in US are likely to apply for patents which are more probable to be licensed by firms (Thursby and Thursby, 2002), which is a significant handicap for researchers analyzing university patents. TTOs "selective patenting" attitude carries the risk of misleading researchers by showing a picture that will look as if universities prefer to focus on "commercializable" research. Therefore, analyses those aim to benchmark technological productivity of and spillovers from universities should involve activities of technology transfer offices.

Several researchers (Göktepe, 2006; Göktepe, 2008; Morgan, et al., 2001; Lissoni et al., 2008; Lissoni et al., 2006) performed more straightforward analysis of patent data, and study general features patents features related with the characteristics of academic inventors, as well as contribution of universities to domestic patents. Lissoni et al. (2006) designed a database relating data on patents, academic inventors (from France, Italy, and Sweden) and universities with each other. They extracted and organized names of academic inventors who participated not only in university, but also industrial patents. First evidence of their study shows that academic scientist contributed to more patents than estimated before (Lissoni et al., 2008). Similarly, Göktepe (2006) studied characteristics of academic inventors and patents (applications) at Lund University from several aspects. She examined the distribution of patents (applications) by faculty and departments, technological field, academic rank of researchers, gender and age. She found that, patents rise and fall with the age of inventors. Up to 50 years old, granted patents are directly proportional to the age of inventors. After 50, it begins to fall. Same pattern is observed in both genders.

Under the light of previous research reviewed above it can be concluded that, regardless of the topics of interest, analyses are focused on patent, inventor, university / faculty triplet. In majority of research authors used patent datasets obtained from patent offices, or surveys made among inventors. It is also found that previous studies examined cross-sections in university / academic patenting process, such as patent-publications relations, inventor characteristics and role of TTOs.

This study approaches university patents as a compound process where pre and post-patent phases should also be taken into consideration. Pre-patent phase refers to research and development activities performed up-to patent application. Post-patent phase refers to commercialization of academic knowledge via licensing and other mechanisms, as well as triggering of patents on consequent research and subsequent patents.

Using the common “patent-inventor-university” ground of previous research, this study offers a robust infrastructure (embodied in UNI-PAT database) supported with qualitative information that does not exist in patent databases, that enables a more comprehensive search on entire patenting process. Please refer to **Appendix 1** for a brief description of terminology used in this study

## 3. Data and Methodology

The scope of this study is limited with the examination of university patents in Turkey that are filed at the Turkish Patent Institute (TPE). The decree law for the foundation of TPE was ratified in 1994[1], and patent applications have been stored in institutional database since then. Therefore, patent applications made before 1994 are not included in this study. All national or international[2] applications filed for patent at the TPE are examined, whereas international applications that skipped the “national phase” at TPE and filed directly at European Patent Office (EPO) or United States Patent and Trademark Office (USPTO) are ignored due to time limitations.

Academic patents are kept out of the study for now, since there was not enough time and organized data to identify all the academics among inventors or applicants. As experienced in other studies (Göktepe, 2006; Göktepe, 2008; Lissoni et al., 2008; Lissoni et al., 2006), it is a very time-consuming task to process all the names of inventors / applicants in patent data and determine academicians among them. Even preparing an academics (or professors) database at the very beginning of research to match the names does not guarantee a perfect verification. Therefore, academic patents are not examined in this study.

University patents are analyzed from three different perspectives: patents, (academic) inventors and universities. All the information at TPE “Patent Search” web site about patents, inventors and applicants is gathered. By the help of additional data, patents are classified according to their,

[1] Full text of decree law-no 544 can be found at http://www.tpe.gov.tr/dosyalar/EN_khk/TPI_DecreeLaw.htm, accessed on October 14, 2010.

[2] There are two types of international patent applications according to their coverage; EPC and PCT. Inventors may file one “international” application in TPE and protect their inventions at EPO, as well as in all other European countries that are parties to the European Patent Convention (EPC). Turkey has been a member of EPC since 2000.
Similarly, inventors may choose to protect their in a larger geography and apply for protection through Patent Cooperation Treaty (PCT). 133 countries in the world signed PCT, where Turkey has become a member in 1996.

industry and technology levels. Inventor data is also enriched with personal information, such as birth date, gender and academic title.

Although the scope is limited with university patents, pre and post-patenting phases are also examined in this study. With semi-structured interviews conducted with inventors of selected patents, university-industry relations during research and development phase, characteristics of research (e.g. funding, team compositions, collaboration and cooperation), and mechanisms behind the "commercialization" of patents are sought. Details about interviews will be explained in the upcoming section.

Methodology of this study can be divided into four steps as follows:

**1.** Collection of patent data and other relevant information
  - **1.1.** Retrieving raw patent data from the Turkish Patent Institute (TPE)
  - **1.2.** Obtaining other data related with patents, inventors and applicants
  - **1.3.** Obtaining IPC, NACE classification data and concordance information

**2.** Organization and standardization of collected data
  - **2.1.** Reorganizing patent data
  - **2.2.** Constructing relations between relevant data
  - **2.3.** Standardizing IPC, NACE classifications and concordance between them

**3.** Designing first version of UNI-PAT database

**4.** Interviews with the inventors of selected patents

## 1. Collection of patent data and other relevant information

### *1.1. Retrieving raw patent data from the Turkish Patent Institute (TPE)*

Turkish Patent Institute (TPE) does not classify patent applications according to the sector or type of the patent owner. Therefore, university patent data required for this study had to be extracted manually from "Patent Search" page at the official web site of the institute (TPE, 2010) by entering keywords (in Turkish) such as "university", "institute", and "faculty" for the applicant – which is in fact the patent owner – criterion. There is still a slim chance that a few patent data were missed due to typos in the name of the applicant.

For each patent, a summary page is displayed (see **Appendix 1** for an example) including application and registration dates, patent type (national or international), name and address of patent owners and inventors, patent title, brief explanation about invention, and International Patent Classification (IPC) codes.

Summary page of each patent search result is copied into a word processing file one by one, constructing an archive of patents to be processed later on.

### *1.2. Obtaining other relevant data from different resources*

Analysis of university patents includes investigation of gender statistics, evaluation of patent performance of universities, and collaboration of inventors. TPE collects nationality / registered country and identification numbers of patent owners, as well as inventors via the application form (see **Appendix 3**). However they are not displayed in the result page. Gender of inventors is another missing data in the dataset. Hence, a manual scan on inventor names is performed to identify their nationalities and genders which are verified by searching through their personal information on the Internet.

To evaluate the performance of universities, an up-to-date list of them is obtained from the Council of Higher Education of Turkey (YÖK, 2010).

### *1.3. Obtaining IPC and NACE classification data.*

There are two ways to analyze patents with respect to different industry areas and fields of technology that they fall into. First way is to seek through patent summary (see the last two sections in **Appendix 1**) and contact inventors when needed to identify the field of research, which is extremely time consuming.

Second and more straightforward way is to use IPC codes, provided in the raw patent data. IPC coding is used to provide a four-level hierarchical system for the classification of patents according to their relevant areas of technology. Therefore, a complete list of up-to-date IPC codes is downloaded from the web site of the World Intellectual Property Organization (WIPO). However, a quick scan on the list showed that with the method in IPC (see **Table 1** for main categories) it is not possible to distinguish patents that fall into certain technology areas such as ICT and biotechnology easily.

**Table 1 - IPC Codes, Main Categories**

| Section | Description |
|---|---|
| A | Human Necessities |
| B | Performing Operations; Transporting |
| C | Chemistry; Metallurgy |
| D | Textiles; Paper |
| E | Fixed Constructions |
| F | Mechanical Engineering; Lighting; Heating; Weapons; Blasting |
| G | Physics |
| H | Electricity |

**Source: World Intellectual Property Organization** (WIPO, 2010).

Sections like *A – Human Necessities* and *F – Mechanical Engineering; Lighting; Heating; Weapons; Blasting* are defined so broad that they include patents related to various technology areas. As an example, *Human Necessities* section includes sub-topics varying from furniture to tobacco and from hygiene to sports instruments (WIPO, 2010). Moreover, inventions related to a certain technology field may be classified under different sections.

It can be concluded from the abovementioned drawbacks that, using IPC codes alone would not provide reliable information to illustrate the characteristics of patents from different technological and sectoral perspectives. Therefore, additional classification standard that would yield more precise results, especially for sectoral analysis, and which can be related with IPC codes was needed.

Since it is accepted as the standard code system of the European Union (EU) for industry classification and is also used in Turkey, NACE (General Name for Economic Activities in the European Union) codes are used in this study to categorize patents. Complete list of NACE is retrieved from the European Union documents (Eurostat, 2008; Schmoch et al., 2003).

**2. Reorganizing the data and constructing the university patent information**

### 2.1. *Processing patent application data*

Patent summaries that are retrieved from TPE are processed in four main categories: basic patent information, patent owner information, inventor information and patent IPC codes. For basic patent information, application number, patent subject, application date (full date and its year), date on which the patent is granted and application coverage data[3] processed and copied into a spreadsheet table. Likewise, tables are constructed for each of the remaining three categories.

### 2.2. *Standardization of IPC, NACE classifications and relations between them*

IPC and NACE codes are reorganized to be represented in a relational database. Each level is processed and its relation with upper level is constructed. Every code is assigned a unique value to ease data processing. In addition, a concordance matrix (Schmidt-Ehmcke and Zloczysti, 2009; Johnson, 2002; Schmoch et al., 2003) is constructed to establish relationship between IPC and NACE codes (see Appendix 4). Concordance matrix made it possible to classify patents according to industries

To take classification one step further to "technology levels", aggregation files are downloaded from Eurostat for NACE and IPC codes (Eurostat, 2010). Downloaded files are manually processed in spreadsheet software and converted into database tables.

## 3. Designing first version of UNI-PAT database

Entire data collected in previous steps are processed according to relational database standards. Each "entity" such as patent, inventor, university, NACE and IPC codes, technology levels, industries are represented by master tables. Relations among master tables are determined, and relation tables are created to represent "many-to-many"[4] relations. Design of UNI-PAT database, including all tables and relations among them, is given in **Appendix 5**.

## 4. Interviews with the inventors of selected patents

It is aimed to obtain qualitative information that could not be retrieved from patent data by conducting semi-structured interviews. First of all, interview questions are determined to acquire pre and post-

[3] Application coverage data defines whether patent owners applied for national or international protection of their invention.

[4] As an example, patents and inventors have many-to-many relationship between them. It means, one inventor may involve in more than one patent record, and one patent may have more than one inventor.

patenting phases. Main goals of interviews were to determine research characteristics of academic inventors, to seek for clues about university-industry relations, understand technology transfer capabilities of universities, as well as degree of "commercialization" of scientific knowledge. Therefore, interviews are conducted for patents (granted or pending) that are selected according to their technology levels and scientific fields. **Table 2** represents the characteristics of six patents subject to interviews. Granted patents were selected especially to analyze the "post-patent" phase. Complexity in research activities is likely to increase directly proportional to the technology level. Hence, at least one patent is selected to represent each technology levels. Since the majority of patent applications were based on research in biotechnology, materials science and chemistry (see **Table 4**), interviews were planned to represent the overall picture.

**Table 2 - Characteristics of Patents Selected for Interviews**

| Patenting Stage | Technology Level | Scientific Field |
|---|---|---|
| Granted | Medium-High | Chemistry |
| | Medium-High | Materials Science / Special Equipment |
| | Medium-Low | Biotechnology |
| Pending | High | Materials Science / Special Equipment |
| | Medium-High | Materials Science / Special Equipment |
| | Medium-Low | Biotechnology |

Information retrieved via interviews is categorized, standardized by using spreadsheet software. After categorization, a large summary table is constructed (see **Table 6** and **Table 7**) to be entered in UNI-PAT database.

## 4. Results and Preliminary Findings for Turkey

Summary statistics based on UNI-PAT database are presented, and preliminary information obtained in interviews is discussed in this section. Statistics are collected in three groups as patents, inventors and universities, depending on their source of data.

## 4.1. Patent Statistics

Keyword search at TPE web page returned 26 results which is the number of patents that Turkish universities have applied for. No doubt that university patents are very few in number, but to mention again, this research does not involve individual academic patent applications. Distribution of university patents between 1994 and 2009 is shown in Figure 1. It can be seen in the figure that, number of university patents do not show a specific pattern until 2004, but starts to increase by 2005. 19 of 26 university patents, which contribute to 73 percent, fall in the last five year interval. The reason of increase may be bound to recent technology and innovation policy applications in Turkey, as well as incentives for public research. However, only one of the interviewees mentioned public incentive during research phase of their patent. In other four interviews, it is seen that no public incentives, such as TUBITAK funds are used. Another explanation for the increase may be developing university-industry relations in Turkey. However there is not enough evidence to prove that explanation in this research for now.

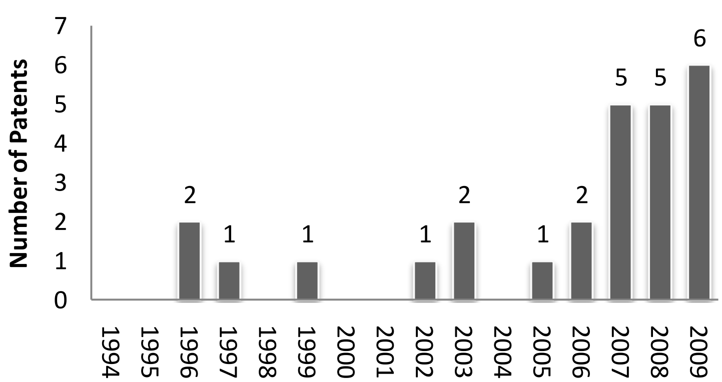



**Figure 1 - University Patents (1994-2009)**

Reorganizing patents with respect to their IPC codes, NACE industrial classification and technology levels would contribute to examine the characteristics of patent-oriented academic research. First, patents are classified by their highest level IPC codes (see **Table 3**). A patent can be classified in more than category, therefore may have more than one IPC code. It is why sum of patents in the table exceeds total number of patents. However, IPC is a very broad way of classifying patents, and does not give reliable information about the industry or level of technology that a patent falls in. As an example, agriculture, furniture production and medical science are all classified under "Human Necessities" topic. A new classification method, e.g. by industry and technology-level, is needed to eliminate the drawback of IPC classification.

**Table 3 - University Patents According to IPC Codes**

| Code | Description | Patents |
| --- | --- | --- |
| A | HUMAN NECESSITIES | 9 |
| B | PERFORMING OPERATIONS; TRANSPORTING | 4 |
| C | CHEMISTRY; METALLURGY | 8 |
| D | TEXTILES; PAPER | 3 |
| F | MECHANICAL ENGINEERING; LIGHTING; HEATING; WEAPONS; BLASTING | 1 |
| G | PHYSICS | 3 |
| H | ELECTRICITY | 1 |
| | **Total*** | **29** |

*: Three patents are classified in two categories.

NACE is chosen as the standard for the industrial categorization of patents, since it is widely used in Turkey, as well as the European Union. Concordance tables, industry and technology level categorization data is present in UNI-PAT database. Industrial / technological classification of patents is given in Table 4. "Multi-categorization" of patents by IPC codes is seen in industrial classification as well. Some patents are represented in more than one industry. Industrial / technological classification shows that universities in Turkey are more "patent-productive" in chemistry, pharmacology and biotechnology fields, which is a quite similar case in European universities, as well (Breschi et al., 2008; Göktepe, 2008). It is not surprising, because each of those three industries – especially chemistry – is extremely large with extensive range of applications. Interviews conducted with academic inventors partly prove this case. Only one of the six university patents was explicitly declared to be "commercialized", and it was a chemical product.

**Table 4 - Patents and Relevant Industries / Technologies**

| Industry / Technology | Patents |
| --- | --- |
| Chemistry, Pharmaceuticals, Biotechnology | 12 |
| Process Engineering, Special Equipment | 7 |
| Mechanical Engineering, Machinery | 4 |
| Instruments | 2 |
| Electrical Engineering | 2 |
| Unclassified | 2 |
| **Total*** | **29** |

*: Three patents are classified in two categories.

Another statistics that can be retrieved from UNI-PAT database about patent characteristics would be the distribution of university patents by technology levels, which is given in **Figure 2**. This statistics can be used to analyze contribution of universities to high-tech research and development. Higher technology levels of patents are included in this statistics to avoid “multi-categorization” problem. It is seen in the graph that, majority of university patents (65 percent in total) in Turkey are classified in “medium-low” or “low” technology levels. There is only one “hi-tech” patent granted to university since 1994, which points out a very weak contribution of universities in high technology fields.

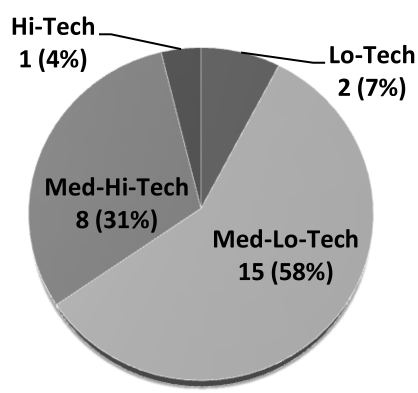



**Figure 2 - Distribution of University Patents by Technology Levels**

## 4.2. Inventor Statistics

There are 63 academic inventors in UNI-PAT database. Database is designed to hold both personal and professional information. Research is still going on to complete the data for each inventor record. Some of personal data and majority of professional data are still missing. Therefore, there are only two statistics that deserve attention about inventors for now.

First one is the about the patent performance of inventors. Breschi (2007) and Göktepe (2008) discuss academic inventors in two categories according to the number of patents they produce: *occasional* and *serial*. Occasional inventors are the ones who produce just one patent in their entire academic life, whereas serial inventors produce a “stream of patents” (Breschi et al., 2007), often related with their first patent. Göktepe (2008) finds that from some point on, university / academic patents are concentrated on serial inventors who push patenting activity further. According to her analysis, an inventor needs to produce five or more patents to be called as a *serial* inventor. Maximum number of patents per inventor in Turkey is three, not as many as in Sweden or Italy. However, it should not be forgotten that, this research includes only university patents. After adding academic patents in following phases of research, below graph may change. For now, it can be concluded that there are nine candidates for *serial inventor* title. Common property of the nine "potentially serial" inventors is that, average time between their two subsequent patents is around one year. In other words, those inventors produced one patent every year (on the average). For a more thorough analysis, academic patent data is still needed.

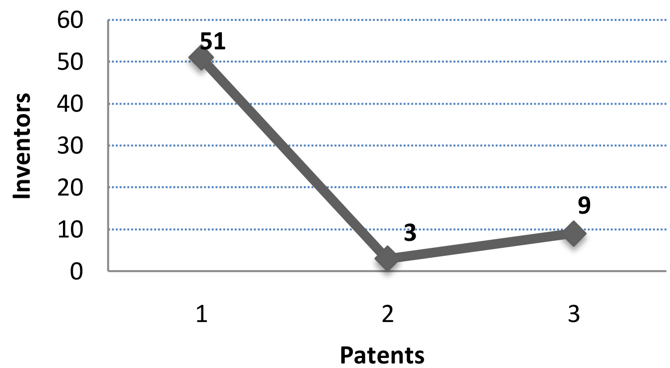



**Figure 3 - Patent Performance of Academic Inventors**

Second statistics about academic inventors is their distribution by gender. According to the recent national statistics, around one third of researchers in Turkey are female (TUBITAK, 2010). When it comes to patents, however, distribution of academic inventors by gender does not reflect the overall picture (see **Error! Reference source not found.**). Ratio of women in academic inventors is quite low (21 percent) with respect to the ratio in national researcher database.

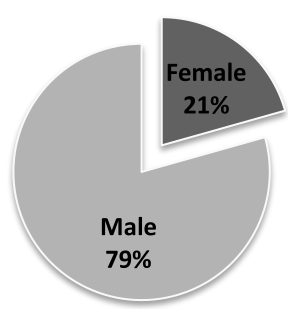
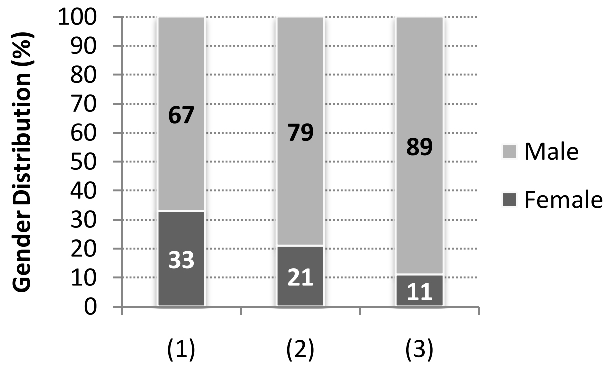



**Figure 4 - Academic Inventors by Gender**

Combining gender with patent performance yields a more interesting result. There are 13 female inventors in UNI-PAT database and 12 of them are occasional inventors. Only one of the nine "potentially serial" inventors is female, which contributes to 11 percent (see **Figure 5**). It can be concluded that representation of women in science is lower in patent-oriented research.




**(1): Full-time researchers, (2): Academic Inventors, (3): "Potentially serial" inventors**

**Figure 5 - Gender Distribution among the Academe**

## 4.3. University Statistics

Entire 26 patents are owned by 14 universities (see **Table 5**). There are seven public and seven private universities in the list. Even though it seems there is an even distribution among public and private universities, patent counts tell a different story. 16 out of 26 university patents are owned by private universities. Moreover, three private universities own three or more patents, whereas public universities own one or two patents.

There are several explanations for the "dominance" of private universities. First, private universities are more enthusiastic about industry relations and show a more organized attitude on commercializing academic research (Morgan et al., 2001). Two of the "top patent owner" private universities have their own patent offices[5], and they take the burden away from the inventor at the patent application phase. Patent licensing revenues can reach to substantial amounts that return to university as an additional funding. Therefore, private universities are more eager to commercialize patents compared to public universities.

[5] Sabanci University established a technology transfer office, named "inovent" in 2006. Bahcesehir University established an in-house patent office in 2009, and the office applied for three patents in the same year.

**Table 5 - Distribution of Patents among Universities**

| Name | Year Est. | Type | Patents |
|---|---|---|---|
| **Anadolu Üniversitesi** | 1982 | Public | 1 |
| **Ankara Üniversitesi** | - | Public | 2 |
| **Atatürk Üniversitesi** | 1957 | Public | 2 |
| **Bahçeşehir Üniversitesi** | 1998 | Private | 3 |
| **Başkent Üniversitesi** | 1993 | Private | 2 |
| **Bilkent Üniversitesi** | 1984 | Private | 1 |
| **Doğu Akdeniz Üniversitesi** | 1979 | Private | 1 |
| **İstanbul Kültür Üniversitesi** | 1997 | Private | 1 |
| **İstanbul Teknik Üniversitesi** | 1773 | Public | 1 |
| **Kocaeli Üniversitesi** | 1992 | Public | 1 |
| **Pamukkale Üniversitesi** | 1992 | Public | 1 |
| **Sabancı Üniversitesi** | 1999 | Private | 4 |
| **Uludağ Üniversitesi** | 1975 | Public | 1 |
| **Yeditepe Üniversitesi** | 1996 | Private | 5 |

At the first glance, lack of top Turkish research / technical universities, like Middle East Technical University and Bogazici University, in the above table seems quite unusual. The reason for their absence can be explained by individual patent applications of academic inventors. It is most likely to find many professors from those universities when academic patent data is collected and added to UNI-PAT database. After that, **Table 5** will probably gain a completely different look. More detailed analysis in this section is therefore left for the completion of research.

## 4.4. Interview Results

Semi-structured interviews conducted with inventors of six patents revealed noteworthy information about research, application and commercialization phases of university patents. Interview questions are given in **Appendix 6**. Results are grouped in two categories: research phase and patenting / commercialization. **Table 6** represents the summary of answers for the research phase. Number of corresponding question for each column is written in parenthesis. First of all, four of the inventors define their main focus of their academic activities as applied research, whereas the other two prefer to focus mainly on basic research. Preliminary results indicate shifting away from basic to applied research as Lee (1996) asserted.

**Table 6 - Summary of Interview Results (Research Phase)**

| Patent No | Research Type (1) | Motive (2) | Duration and Funding: Time-Year (3) | Funding (8)* | Research Team: Size (4) | Composition (5)** | Interdiscp. (6) | Research Outputs: Thesis (10) | SCI Pub. (10) | New Product? (13) |
|---|---|---|---|---|---|---|---|---|---|---|
| **3** | Basic Research | Inventor's Idea | 2 | b | 4 | a,c | Yes | 1 | 1 | No |
| **6** | Applied Research | New Product | 6 | b,c | 4 | a | No | 0 | 3 | Yes |
| **15** | Basic Research | Inventor's Idea | 4 | a,b | 4 | a | Yes | 3 | 3 | No |
| **16** | Applied Research | New Product | 1.5 | a,c | 6 | a,b | Yes | 0 | 2 | Not Yet |
| **21** | Applied Research | Previous Research | 2 | a,b | 3 | a | No | 2 | 9 | No |
| **26** | Applied Research | Previous Research | 0.5 | a | 3 | a,b | No | 0 | 1 | No |

*** a: University resources, b: Public research funds (e.g. TUBITAK), c: Foreign funds (e.g. European Union, NATO), d: Private Sector**
**** a: Faculty staff, b: Researchers from other universities, c: Researchers from public research institutions, d: Private Sector**

Results indicate a weak or no university-industry relation at the research phase. None of the patents were the results of industry-driven research. Two thirds of patents carried the individual enthusiasm of inventors who started research either to end up with a new product or an alternative solution. Moreover none of the patents are co-owned by private sector. Weak university-industry relation is seen in the source of research funds as well. None of six patents were funded by private sector at the research phase. On the other hand, universities are not opposed to using external finance for their research. It can be seen in **Table 6** that, they prefer to benefit from public research funds, such as project support provided by TUBITAK. Four of interviewees stated that they used public funds, and one of them declared that entire research project was funded by TUBITAK. Foreign financial resources, such as European Union were used in two patents.

Another thing to discuss here will be the outputs of research as publications and / or new products. Majority of authors, as discussed in previous sections, focus on the relation between patents and "overall" publications of academic inventors. Evaluating "overall" academic performance does not provide sufficient information about "patent-related" spillovers in academe. Scientists may not search for patents, but they read articles in periodicals. Publications are the major "free" knowledge diffusion mechanisms among scientists. Therefore, analyzing publications about "patent-producer" research, particularly the articles that enter Science Citation Index (SCI), would be more appropriate to evaluate such spillovers. Revisiting **Table 6**, it is seen that there is at least one indexed publication for each university patent subject to interviews.

Answers given by inventors for the patenting / commercialization category are summarized in **Table 7**. All universities filed EPC or PCT applications for international protection of inventions, which became a routine in patenting. Problems with patent applications were not intended to ask at the beginning, but after very first interview, it is realized that academic inventors at public universities suffer from exhausting application procedures, lack of assistance and insufficient funds. Inventors at private universities without patent offices or TTOs experience similar problems. One of the interviewees, a molecular biology professor, said that he had to prepare all the documents, since patent attorneys had no idea on the subject. Another professor had to pay all the application fees himself. Those are serious drawbacks which may significantly hamper the increase in the ratio of university patents among others. Inventors working at universities that have TTOs declared that they had no problems with patenting.

Commercialization of patents is a common weakness of universities in Turkey, even though they have TTOs. There is only one case where successful licensing is made, and one case where university is about to negotiate with a private sector company.

**Table 7 - Summary of Interview Results (Patenting / Commercialization)**

| | Patent and Protection | | Commercialization | |
|---|---|---|---|---|
| Patent No | International Application? (11) | Problems with Application? (12) | License Given (14) | Market and Income Expectations (15) |
| **3** | Yes | Yes | No | No |
| **6** | Yes | Yes | Given to a German Firm | 1,000,000 USD |
| **15** | Yes | No | No (TTO is working on it) | Don't Know |
| **16** | Yes | Yes | In Progress | Don't Know |
| **21** | Yes | No | No (TTO is working on it) | Don't Know |
| **26** | Yes | - | No | - |

## 5. Conclusions and Implications for Further Research

First conclusion to make out of this study is that, university patenting is at its early stages in Turkey. Although there has been a steady increase in university patents, the number is still extremely low. In line with the general trend in the US and Europe, private universities are more eager to apply for patents than public universities. Public research funds are being used in research activities, but it is seen that university-industry relations are still weak in both pre and post-patent phases. Commercialization of patents is also seen as another weakness of universities. There are only a few technology transfer offices, and they are still gaining experience on the subject.

From the inventors perspective it can be stated serial academic inventors have begun to emerge. There is an essence of collaboration in research phase but it is also limited. “Interdisciplinary” research is found to be completely bound to the subject of research. Finally, it is seen that participation of women in university patents is considerably low.

Results and findings in this research should be considered as “preliminary”. They will not reflect the whole picture unless academic patents are included in analyses. In addition, more interviews should be conducted with as many inventors as possible for a more realistic analysis of pre and post-patent phases. Since the main aim of this study is to develop a methodology for the analysis of university patents, it is always open to further improvements in the future.

Further research is definitely needed to construct a comprehensive infrastructure that provides more reliable information for thorough and detailed analysis of university / academic patents and their impacts e.g. on diffusion of knowledge, technology transfer and development, and innovation. A checklist for the following steps of this research would be as follows:

- *Completing missing information in UNI-PAT database*: Some of the information about inventors, like date of birth, academic title, date of PhD degree is still missing. Moreover, university information needs to be enriched by including faculties, department sizes, technopark and TTO existence.
- *Investigating academic patents:* Research subject to this paper cover only university (owned) patents. Analyses will be misleading when academic patents are not included. Examining academic patents is the hardest, most time consuming and exhaustive item in this checklist, since any patent where an academic inventor is involved counts.
- *Searching for patent-related publications and patent citations:* To examine the diffusion of knowledge created by patents through academe, patent-related publications and citations should be included in the research. Method for collection and processing of data will be decided later.
- *Reviewing interview questions:* A more structured interview is needed to gather qualitative information. Therefore, interview questions should be reviewed.
- *Redesigning UNI-PAT database:* Based on the type and relations of information gathered in above states, UNI-PAT database will be redesigned. Data entry and keeping information up-to-date are other tasks to be performed at this step.

# Appendices

## Appendix 1 Conceptual Clarification

***Patents / Patent Applications:*** It was noticed during the first scan of dataset that, it took up to six years for a patent application to be granted, which is a common issue due to lingering examinations and investigations performed by patent offices (Schankerman and Pakes, 1986; Griliches, 1990). Average duration for an application in dataset to be granted with patent is calculated to be about four years. 80 percent of applications filed between 1994 and 2006 were granted by the end of 2009. It would not be misleading to infer that most of the patent applications filed after 2006 would be granted by the end of 2010. **Therefore, the term "patent" is used instead of "patent application" in this paper for simplification**.

***University Patents:*** The term is used for patents owned by or patent applications filed by the universities. Patents co-owned by universities, or patent applications where the university is one of the applicants are also considered as university patents.

***Academic Patents:*** It is used for patents owned by or patent applications filed by one or more academics. Patents that include at least one academician among inventors is considered as an academic patent. Patents classified as *university patents* are not classified in this category.

## Appendix 2 Sample Patent Search Result Page (Titles are translated into English)

### Application Information

| | | |
|---|---|---|
| **Application No** : 2008/09083 | **Document No** : 2008-G-248063 | **Registration No** : 2008 09083 |
| **Application Date** : 2006/06/13 | **Document Date** : 2008/11/27 | **Registration Date** : 2009/01/21 |
| **Application Type** : EPC Fasikül | **Protection Type** : Patent | **Publication Date** : |
| **EPC App. No** : EP06404002.5 | **EPC Publication** : EP1867762B1 | **EPC Bulletin Date** : 2008/09/10 |

### Applicants

**SABANCI ÜNİVERSİTESİ**
34956 Tuzla İSTANBUL
**TÜBİTAK Türkiye Bilimsel ve Teknolojik Araştırma Kurumu**
06100 Kavaklıdere ANKARA

### IPC Classification

D01D 5/00
D01F 9/12

### Inventors

**Burak Birkan**
34956 Tuzla İSTANBUL
**Mehmet Ali Gülgün**
34956 Tuzla İSTANBUL
**Yusuf Ziya Menceloğlu**
34956 Tuzla İSTANBUL

### Attorney

*Name, company and address of the attorney is written here.*

### Title of Invention

Katalitik malzeme nano-parçacıkları içeren karbon nanofiberler.

### Summary of Invention

Buluş, ortalama parçacık boyutu 0,5 ila 40nm arasında değişen katalitik malzeme parçacıkları içeren karbon nano-fiberleri sentezlemek için bir yönteme ilişkindir ve aşağıdaki basamakları içerir a) katalitik malzeme öncüsü ve polimer çözeltisi elektrospin yapılarak katalitik malzeme öncü parçaları elde edilir, b) a) basamağında elde edilen ürün indirgen bir madde ile indirgenerek katalitik malzeme parçacıkları içeren polimer fiber oluşturulur, c) b) basamağında elde edilen ürüne ısı ile muamele edilerek katalitik malzeme parçacıkları içeren polimer fiberleri, katalitik malzeme parçacıkları içeren karbon fiberlere dönüştürülür.

## Appendix 3 TPE Patent Application Form (First Page, in Turkish)

TÜRK PATENT ENSTİTÜSÜ

**TPE-P-101**
PATENT
BAŞVURU FORMU

TPE
Barkod Alanı

**1. Buluş Başlığı**
Buluşu kısaca tanımlamalı; marka niteliğindeki terimleri içermemelidir.

**Title of Invention**

**2. Uluslararası Patent Sınıfı**
Buluşun patent sınıfını biliyorsanız yazınız. Bilmiyorsanız boş bırakınız.

**IPC Classification**

**3. Başvuru Sahibi**
Gerçek kişi ise ad ve soyad, tüzel kişi ise kuruluşun tam ve açık unvanını yazınız.

**Name / Title of Patent Owner**

**3.1. Uyruk/Kayıtlı Ülke**
Gerçek kişi ise uyruğunu, tüzel kişi ise kayıtlı olduğu ülkeyi belirtiniz.

**Nationality**

**3.2. T.C. Kimlik/Vergi No**
Gerçek kişiler için T.C. kimlik no, tüzel kişiler için vergi no ve dairesini giriniz.

**(Turkish / Tax) ID Number**

**3.3. Adres**
Yazışma adresini (şehir, ülke ve varsa posta kodu bilgilerini içerecek şekilde) yazınız.

**Address / Phone / e-mail**

**3.4. Telefon/Faks/E-posta**

☐ Başvuru sahibi birden fazla ise, bu kutucuğu işaretleyerek diğer sahiplere ait bilgileri **ek sayfada** belirtiniz.

**4. Buluş Sahibi**
Buluş sahibi gerçek kişinin ad ve soyadını yazınız.

**Name of the Inventor**

**4.1. Uyruk**
Buluş sahibinin uyruğunu belirtiniz.

**Nationality**

**4.2. T.C. Kimlik No**
Buluş sahibi T.C. vatandaşı ise, T.C. kimlik numarasını giriniz.

**(Turkish / Tax) ID Number**

**4.3. Adres**
Yazışma adresini (şehir, ülke ve varsa posta kodu bilgilerini içerecek şekilde) yazınız.

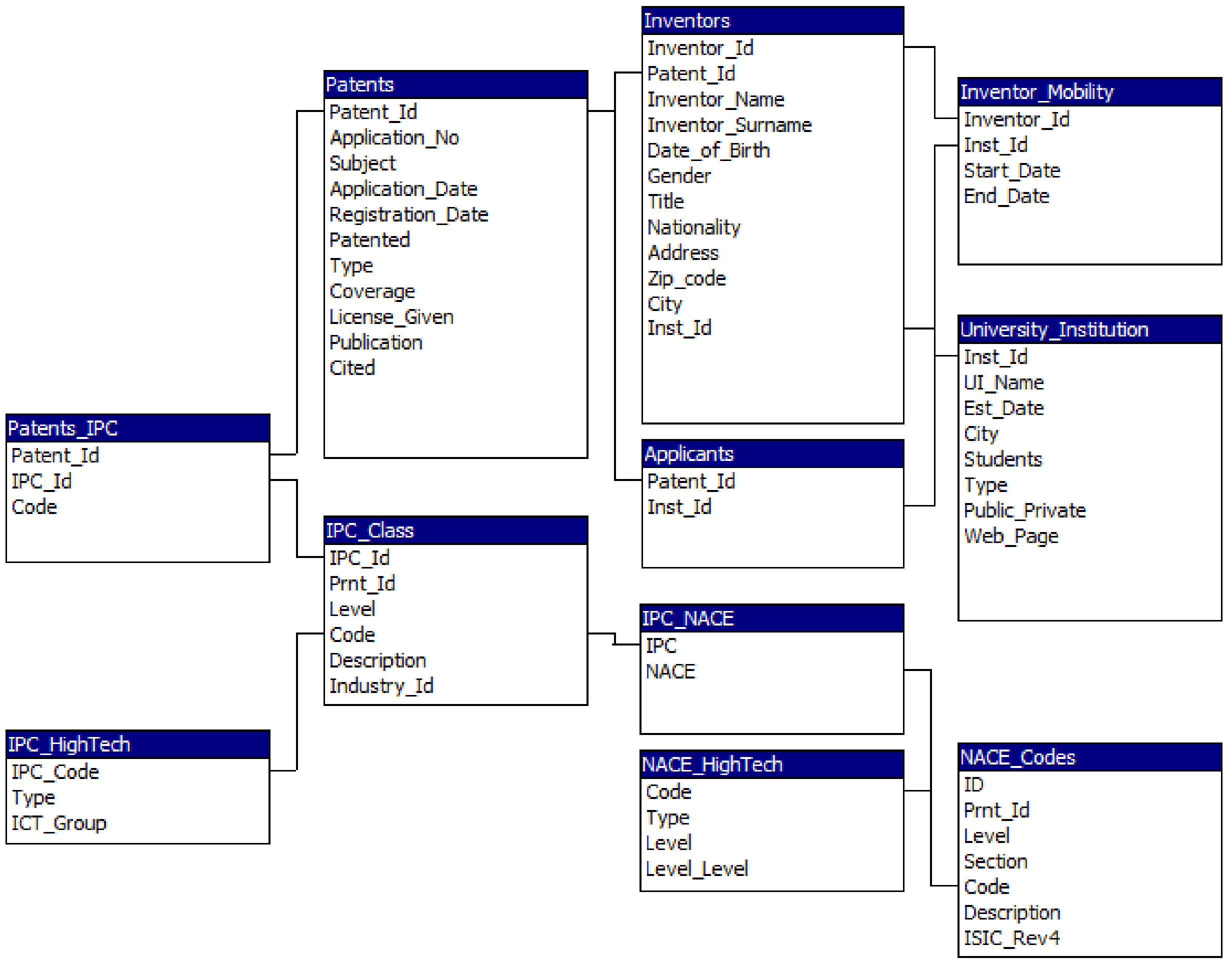
**Address**

## Appendix 4 NACE – IPC Concordance Table

| NACE Codes | Corresponding IPC Codes |
|---|---|
| **15** | A01H, A21D, A23B, A23C, A23D, A23F, A23G, A23J, A23K, A23L, A23P, C12C, C12F, C12G, C12H, C12J, C13F, C13J, C13K |
| **16** | A24B, A24D, A24F |
| **17** | D04D, D04G, D04H, D06C, D06J, D06M, D06N, D06P, D06Q |
| **18** | A41B, A41C, A41D, A41F |
| **19** | A43B, A43C, B68B, B68C |
| **20** | B27D, B27H, B27M, B27N, E04G |
| **21** | B41M, B42D, B42F, B44F, D21C, D21H, D21J |
| **23** | C10G, C10L, G01V |
| **24.1** | B01J, B09B, B09C, B29B, C01B, C01C, C01D, C01F, C01G, C02F, C05B, C05C, C05D, C05F, C05G, C07B, C07C, C07F, C07G, C08B, C08C, C08F, C08G, C08J, C08K, C08L, C09B, C09C, C09D, C09K, C10B, C10C, C10H, C10J, C10K, C12S, C25B, F17C, F17D, F25J, G21F |
| **24.2** | A01N |
| **24.3** | B27K |
| **24.4** | A61K, A61P, C07D, C07H, C07J, C07K, C12N, C12P, C12Q |
| **24.5** | C09F, C11D, D06L |
| **24.6** | A62D, C06B, C06C, C06D, C08H, C09G, C09H, C09J, C10M, C11B, C11C, C14C, C23F, C23G, D01C, F42B, F42D, G03C |
| **24.7** | D01F |
| **25** | A45C, B29C, B29D, B60C, B65D, B67D, E02B, F16L, H02G |
| **26** | B24D, B28B, B28C, B32B, C03B, C03C, C04B, E04B, E04C, E04D, E04F, G21B |
| **27** | B21C, B21G, B22D, C21B, C21C, C21D, C22B, C22C, C22F, C25C, C25F, C30B, D07B, E03F, E04H, F27D, H01B |
| **28** | A01L, A44B, A47H, A47K, B21K, B21L, B22F, B25B, B25C, B25F, B25G, B25H, B26B, B27G, B44C, B65F, B82B, C23D, C25D, E01D, E01F, E02C, E03B, E03C, E03D, E05B, E05C, E05D, E05F, E05G, E06B, F01K, F15D, F16B, F16P, F16S, F16T, F17B, F22B, F22G, F24J, G21H |
| **29.1** | B23F, F01B, F01C, F01D, F03B, F03C, F03D, F03G, F04B, F04C, F04D, F15B, F16C, F16D, F16F, F16H, F16K, F16M, F23R |
| **29.2** | A62C, B01D, B04C, B05B, B61B, B65G, B66B, B66C, B66D, B66F, C10F, C12L, F16G, F22D, F23B, F23C, F23D, F23G, F23H, F23J, F23K, F23L, F23M, F24F, F24H, F25B, F27B, F28B, F28C, F28D, F28F, F28G, G01G, H05F |
| **29.3** | A01B, A01C, A01D, A01F, A01G, A01J, A01K, A01M, B27L |
| **29.4** | B21D, B21F, B21H, B21J, B23B, B23C, B23D, B23G, B23H, B23K, B23P, B23Q, B24B, B24C, B25D, B25J, B26F, B27B, B27C, B27F, B27J, B28D, B30B, E21C |
| **29.5** | A21C, A22B, A22C, A23N, A24C, A41H, A42C, A43D, B01F, B02B, B02C, B03B, B03C, B03D, B05C, B05D, B06B, B07B, B07C, B08B, B21B, B22C, B26D, B31B, B31C, B31D, B31F, B41B, B41C, B41D, B41F, B41G, B41L, B41N, B42B, B42C, B44B, B65B, B65C, B65H, B67B, B67C, B68F, C13C, C13D, C13G, C13H, C14B, C23C, D01B, D01D, D01G, D01H, D02G, D02H, D02J, D03C, D03D, D03J, D04B, |

| | |
|---|---|
| | D04C, D05B, D05C, D06B, D06G, D06H, D21B, D21D, D21F, D21G, E01C, E02D, E02F, E21B, E21D, E21F, F04F, F16N, F26B, H05H |
| **29.6** | B63G, F41A, F41B, F41C, F41F, F41G, F41H, F41J, F42C, G21J |
| **29.7** | A21B, A45D, A47G, A47J, A47L, B01B, D06F, E06C, F23N, F24B, F24C, F24D, F25C, F25D, H05B |
| **30** | B41J, B41K, B43M, G02F, G03G, G05F, G06C, G06D, G06E, G06F, G06G, G06J, G06K, G06M, G06N, G06T, G07B, G07C, G07D, G07F, G07G, G09D, G09G, G10L, G11B, H03K, H03L |
| **31.1** | H02K, H02N, H02P |
| **31.2** | H01H, H01R, H02B |
| **31.3** | H01H, H01R, H02B |
| **31.4** | H01M |
| **31.5** | F21H, F21K, F21L, F21M, F21S, F21V, H01K |
| **31.6** | B60M, B61L, F21P, F21Q, G08B, G08G, G10K, G21C, G21D, H01T, H02H, H02M, H05C |
| **32.1** | B81B, B81C, G11C, H01C, H01F, H01G, H01J, H01L |
| **32.2** | G09B, G09C, H01P, H01Q, H01S, H02J, H03B, H03C, H03D, H03F, H03G, H03H, H03M, H04B, H04J, H04K, H04L, H04M, H04Q, H05K |
| **32.3** | G03H, H03J, H04H, H04N, H04R, H04S |
| **33.1** | A61B, A61C, A61D, A61F, A61G, A61H, A61J, A61L, A61M, A61N, A62B, B01L, B04B, C12M, G01T, G21G, G21K, H05G |
| **33.2** | F15C, G01B, G01C, G01D, G01F, G01H, G01J, G01M, G01N, G01R, G01S, G01W, G12B |
| **33.3** | G01K, G01L, G05B, G08C |
| **33.4** | G02B, G02C, G03B, G03D, G03F, G09F |
| **33.5** | G04B, G04C, G04D, G04F, G04G |
| **34** | B60B, B60D, B60G, B60H, B60J, B60K, B60L, B60N, B60P, B60Q, B60R, B60S, B60T, B62D, E01H, F01L, F01M, F01N, F01P, F02B, F02D, F02F, F02G, F02M, F02N, F02P, F16J, G01P, G05D, G05G |
| **35** | B60F, B60V, B61C, B61D, B61F, B61G, B61H, B61J, B61K, B62C, B62H, B62J, B62K, B62L, B62M, B63B, B63C, B63H, B63J, B64B, B64C, B64D, B64F, B64G, E01B, F02C, F02K, F03H |
| **36** | A41G, A42B, A44C, A45B, A45F, A46B, A46D, A47B, A47C, A47D, A47F, A63B, A63C, A63D, A63F, A63G, A63H, A63J, A63K, B43K, B43L, B44D, B62B, B68G, C06F, F23Q, G10B, G10C, G10D, G10F, G10G, G10H |

# Appendix 5 UNI-PAT Database Design



## Appendix 6 Interview Questions

1. Which of the following define your work best?
   a) Basic Research
   b) Applied Research
   c) Development Research
2. What did trigger your research that ended up with this patent?
   a) An idea of inventor(s) / researcher(s)
   b) Outcomes / results of another research
   c) A request from private sector
   d) Other
3. How long did research take?
4. How many researchers were there in the team?
5. Did R&D team include researchers outside of your university?
   a) Included researchers from other universities
   b) Included researchers from public / private research institutions
   c) Included researchers from private sector
6. Did the team include researchers from different academic disciplines?
7. How much did the R&D phase cost (in Turkish Liras)?
8. How did you finance R&D (with ratios, if possible)?
   a) University's own resources
   b) Domestic resources, such as TUBITAK Project Support Programs.
   c) Foreign resources, such as European Union Framework Programs.
   d) Private sector
9. Being a highly uncertain process, did you manage to reach your goals at the end of R&D activities? If not, please evaluate the outcomes.
10. Have you made any publications based on your research? If so, how many of them have entered Science Citation Index?
11. Did you apply for patents in countries other than Turkey? If so, what are the names of those countries?
12. Did you experience any problems during your patent application? If so, what were they?
13. Has the patent granted for your research turned into a new product itself, or used in an existing product?
14. Have you made any business agreements (including licensing), or cooperated with private sector for the commercialization of your patent?
15. Can you give brief information about the value, sales, and market share of the product and briefly discuss your expectations and outcomes of the commercialization process?
16. Have you initiated further research projects related to your invention? If so, what are your future expectations?

# References


Azoulay, P., Din, W., and Stuary, T. (2009). The Impact of Academic Patenting on the Rate, Quality and Direction of (Public) Research Output. *The Journal of Industrial Economics , 57* (4), 637-676.

Breschi, S., Lissoni, F., and Montobbio, F. (2007). The Scientific Productivity of Academic Inventors: New Evidence from Italian Data. *Economics of Innovation and New Technology , 16* (2), 101-118.

Breschi, S., Lissoni, F., and Montobbio, F. (2008). University Patenting and Scientific Productivity: A Quantitative Study of Italian Academic Inventors. *European Management Review , 35,* 91-1091.

Caro, J. M., de Lucio, I. F., and Gracia, A. G. (2003). University Patents: Output and Input Indicators … of What? *Research Evaluation , 12* (1), 5-16.

Eurostat. (2010). *High-tech industry and knowledge-intensive services*. Retrieved August 10, 2010, from Eurostat: http://epp.eurostat.ec.europa.eu/cache/ITY_SDDS/en/htec_esms.htm

Eurostat. (2008). *NACE Rev.2 Statistical Classification of Economic Activites.* Luxembourg: Office for Official Publications of the European Communities.

Geuna, A. (1999). *The Economics of Knowledge Production.* Cheltenham and Northampton: Edward Elgar.

Geuna, A., and Nesta, L. J. (2006). University Patenting and its Effects on Academic Research: The Emerging European Evidence. *Research Policy , 35*, 790–807.

Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P., and Trow, M., et al. (1994). *The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies.* London: SAGE Publications.

Göktepe, D. (2008). A Theoretical Framework for Understanding University Inventors and Patenting. *Jena Economic Research Papers , 31*.

Göktepe, D. (2006). *Identification of University Inventors and University Patenting Patterns at Lund University: Conceptual- Methodological and Empirical Findings.* Retrieved June 29, 2010, from Munich Personal RePEc Archive: http://mpra.ub.uni-muenchen.de/1628/

Griliches, Z. (1990). Patent Statistics as Economic Indicators: A Survey. *Journal of Economic Literature , 28*, 1661-1707.

Henderson, R., Jaffe, A. B., and Trajtenberg, M. (1998). Universities as a source of Commercial Technology: A Detailed Analysis of University Patenting, 1965-1988. *The Review of Economics and Statistics , 80* (1), 119-127.

Jaffe, A. B. (1989). Real Effects of Acemic Research. *The American Economic Review , 79* (5), 957-970.

Johnson, D. K. (2002). The OECD Technology Concordance (OTC): Patents by Industry of Manufacture and Sector of Use. *STI Working Papers , 5*.

Lee, Y. S. (1996). 'Technology Transfer' and the Research University: A Search for the Boundaries of University-Industry Collaboration. *Research Policy , 25* (6), 843-863.

Lissoni, F., Llerena, P., Mc Kelvey, M., and Sanditov, B. (2008). Academic Patenting in Europe: New Evidence from the KEINS Database. *Research Evaluation , 17* (2), 87-102.

Lissoni, F., Sanditov, B., and Tarasconi, G. (2006). *The KEINS Database on Academic Inventors: Methodology and Contents (CESPRI Working Paper 181).* Milano: Centro di Ricerca sui Processi di Innovazione e Internazionalizzazione.

Louis, K. S., Blumenthal, D., Gluck, M. E., and Stoto, M. E. (1989). Entrepreneurs in Academe: An Exploration of Behaviors among Life Scientists. *Administrative Science Quarterly , 34* (1), 110-131.

Morgan, R. P., Kruytbosch, C., Kannankutty, N. (2001). Patenting and Invention Activity of U.S. Scientists and Engineers in the Academic Sector: Comparisons with Industry. *Journal of Technology Transfer , 26,* 173-183.

Owen-Smith, J., and Powell, W. W. (2001). To Patent or Not: Faculty Decisions and Institutional Success at Technology Transfer. *Journal of Technology Transfer , 26,* 99-114.

Pavitt, K. (1998). Do Patents Reflect the Useful Research Output of Universities? *Research Evaluation , 7* (2), 105-112.

Schankerman, M., and Pakes, A. (1986). Estimates of the Value of Patent Rights in European Countries During the Post-1950 Period. *The Economic Journal , 96*, 1052-1076.

Schmidt-Ehmcke, J., and Zloczysti, P. (2009). *Research Efficiency in Manufacturing – An Application of DEA at the Industry Level.* Berlin: Deutsches Institut für Wirtschaftsforschung.

Schmoch, U., Laville, F., Patel, P., and Frietsch, R. (2003). *Linking Technology Areas to Industrial Sectors - Final Report to the European Commission, DG Research.* Karlsruhe, Paris, Brighton: European Commission.

Stephan, P., Gurmu, S., Sumell, A. J., and Black, G. (2007). Who's Patenting in the University? Evidence from the Survey of Doctorate Recipients. *Economics of Innovation and New Technology , 16* (2), 71-99.

Thursby, J. G., and Thursby, M. C. (2002). Who Is Selling the Ivory Tower? Sources of Growth in University Licensing. *Management Science , 48* (1), 90-104.

TPE. (2010). *Patent Search Page*. Retrieved July 25, 2010, from Turkish Patent Institute: http://online.tpe.gov.tr/EPATENT/servlet/EPreSearchRequestManager

TUBITAK. (2010). *ARBIS Istatistikleri*. Retrieved August 20, 2010, from TUBITAK - ARBIS: https://arbis.tubitak.gov.tr/pages/bilgipinari/user/index.jsp

Van Pottelsberghe, B., and Saragossi, S. (2003). What Patent Data Reveal about Universities: The Case of Belgium. *Journal of Technology Transfer , 28* (1), 47-51.

WIPO. (2010). *IPC - IT support: Toolbox.* Retrieved July 20, 2010, from WIPO - IP Services: http://www.wipo.int/classifications/ipc/en/ITsupport/tools/index.html

YÖK. (2010, July). *Universities*. Retrieved July 30, 2010, from The Council of Higher Education: http://www.yok.gov.tr/en/content/view/527/222/