Dynamics of innovation in a regional system. The flow of industrial knowledge through analysis of the industrial property.

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Abstract. The information contained in patent databases can be used to perceive the innovation strategy of a region. This paper proposed measures on patent analysis as method of measuring the flow of industrial knowledge in a region. The use of Tech- mining applied to the patent and the utility models databases which content the innovation requested by the companies in the area, permits visualized the flow of industrial knowledge along the years. It is possible to detect of knowledge transfers from traditional emergent sectors to emergent business. Although the results of one specific region case may be not be generally applicable due to the size of the region, this paper proposed a useful tool for visualizing the industrial innovation knowledge using Patents as indicator and tech-mining as analyzed tool. The knowledge of the industrial innovation flows, enables the establishing of vital conclusions as regards the finding of a definition for the innovation strategy of a region.

I. INTRODUCTION

The measurement of technological change is of increasing importance for business, research and policy. Detailed information is needed to take right institutional decisions to invest in the fields where innovation promises highest economic returns for the region.

Invention Patents as well as Utility Models requested by the different countries and/or regions identify the innovation capacity and, therefore, the economic development potential of the region.

Patent statistics provide a measure of innovation output, as they reflect the inventive performance of countries, regions, technologies, firms, etc. They are also used to track the level of diffusion of knowledge across technology areas, countries, sectors, firms, etc., and the level of internationalisation of innovative activities. The use of patents to assess the innovation in a particular country has been addressed by various works, as Tansey and Stembridge [1]. Patent indicators can serve to measure the output of R&D, its productivity, structure and the development of a specific technology/industry.

Conversely, patents can also be used as an input indicator, as they represent a source of information for subsequent inventors so, topic of patents as sources of technological knowledge can be found in Gray and Meister [2].

Patent indicators have many advantages [5],[20], mainly: *i)* they have a close link to inventions though the degree of innovation may be put to question and thus this becomes a robust indicator *ii)* they cover a broad range of technologies on which there are sometimes few other sources of data; it enables comparison since there are long lapses of time available *iii)* the contents of patent documents are a rich source of information; and *iv)* patent data are readily available from patent offices. For the purposes of our study the inventions database in Spanish of the Spanish Office for Patents and Brands was used.

However, patents are also subject to certain drawbacks: *i)* the difficulty to measure the economic impact of the invention by means of the marketing of the patent. To this regard, different methods have been developed to measure patents impact [9] *ii)* many inventions are not patented because they are not patentable or inventors many protect their inventions using other methods, such as secrecy, lead time, etc, and finally, others such iii) the changes in patent law over the years make it difficult to analyze trends over time.

Its value as an indicator of technological activity can be attributed to a variety of factors [5] such us: patents are a direct outcome of the inventive process; they are an objective measure since an invention has to be approved by the government in order to become effective; since obtaining patents represents the anticipated benefit to be derived from the commercialization of the product in question and, therefore, this can be used as a measure of innovation.

As regards the methods for analysis of said statistics, we can mention the methods for extraction of information set forth in Zhu and Porter [3] and other authors. It is remarkable the use of bibliometric indicators in their contributions. However, there are few references about patents use analysis in specific sectors and even less about the choice of Patentometrics for conducting surveys, as the entitled Benchmarking R & D study developed by Dou states [4]. In this work, reference studies such as those of Han et al. [5] are referenced.

The possibilities of techmining technologies with roots in bibliometrics and text-mining, permits to go one step further in the information analyzed. Specifically, facilitate the analysis cluster or dimensional to display information. These maps show flows of knowledge

In the words of Han et al. [5], valuable information can be derived by cautiously using patent data. In addition, patents can serve as a prior diagnostic tool for strategic R&D planning and more importantly, as a good indicator fro generated knowledge and knowledge flows.

II. METHOD. SAMPLE-GETTING, EXTRACTION AND FILTRATION OF PATENTS DATABASE.

Bibliographical data on Patents and Utility Models which have been requested by private people or companies from Alava from the 25th May 1960 to the 31st December 2006 was obtained from the databases of inventions in Spanish and belonging to the Spanish Office for Patents and Brands. The Sample contained 2297 records, 30% out of which comes as an answer to Patents requests, new at excellent level, and a 70% to Utility Models new at national level. The referential data derived for analysis was the following: the application number, issuance number, Patents International Classification, title and summary, priority number, dates, applicant and inventor and countries appointed to at issuance for the PCT-Patent Cooperation Treaty procedure.

Once filtered, the information was prepared for import by the software SPSS 14.0 and Vantage point (developed by search technology) and later analyzed using different techniques: statistics counting, frequencies, grouping, co-occurrence of words, cluster analysis.

III. PRELIMINARY RESULTS. DEVELOPMENT OF THE REGION-PATENT AND UTILITY MODEL EVOLUTION

The first piece of data on the evolution of the applications shows, in the figure 1, a constant reduction in the number of requests of innovation registrations in a sustained way along the years at a yearly 3.8% rate, when the innovative intensity of the region decreases.

If we discriminate the sample by the fields, application date and date of concession, this will enable our determining that out of the 2297; just an 8% was turned down while the rest of them were granted. Therefore, the patents and models requested are very robust, a thing which reflects that when they get to the Industrial Registry, the innovation obtained is successful and new at worldwide level.

Another determining point is the contemporariness of patents, until the year 2006, 63% of the granted patents was still in force. Out of the patents still in force, 55% will be 10 years or less in force and the other 45% for more than ten years. In short, 29% of the applied for and granted patents is more than ten years´ life. This piece of data shall frame later conclusions on the advance of R&D in Alava.

If we prepare a diagram relating Patents numbers to the years, we can classify the sample into three time lapses; those requested in the decade 1980-1990, and from 2000 to 2006. We can see in the figure 2, the evolution of the IPCs. The Y-axis represent the first year in which appear one new International Patent Classification in the records. We can appreciate that in 1960 basic industry is composed by: Consumer goods industry (668 records), Civil engineering (346 records), Mechanical elements (210 records). Later in 1970 and 1980 is possible to appreciate the introduction of innovation activities in sectors such us: chemical, medical technology, optics, and finally in the year 2000 and subsequent the new innovations correspond to environmental technologies, semiconductors, pharmaceuticals and cosmetic.

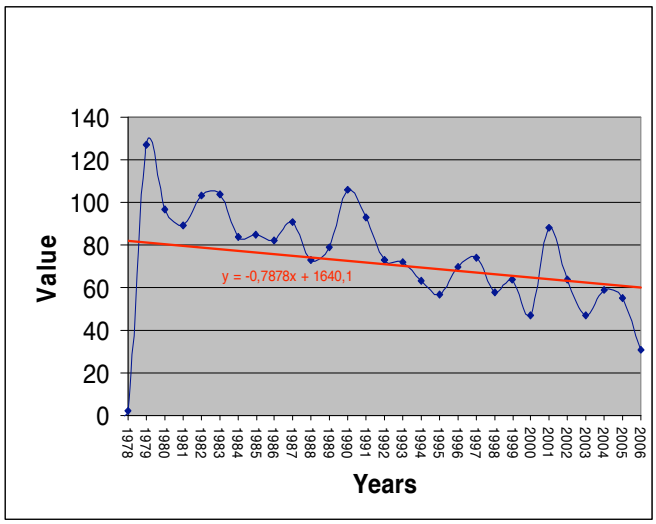

Fig 1. Patent and Utility Models evolution from 1978-2006

IV. APPLICANTS´ ANALYSIS. WHO IS INNOVATING? AND WHERE CAN THEY BE FOUND?

Who are those doing research in Alava? The sample shows that 58% of the patents have been applied for by private people and that 42% has been requested by industrial companies. The nationality of the applicants is in a 97.34% Spanish. We could say if faced with this data that innovation is well disseminated.

Nevertheless, in fact, 58.5% of the applicants of the sample have only registered an innovation once in their history, 17.1% twice and the remaining 24.4% applies to the rest of the innovations.

The most innovative companies belong to different sectors: the toy making industry, the cast iron industry, the portable batteries manufacturing one, the PVC pipes and accessories manufacturing one, shock absorbers and pneumatic springs manufacturing, etc.

If we grouped the sample based on the correspondence of industrial sectors with the International Classification codes of patents given by Hidalgo [8], we could determine that the industrial sectors which have fostered the R&D industry in Alava. In the figure 3 you can appreciate that the innovation process which finish in applied Patens and Utility models have been of a 37.28% companies involved in civil engineering and consumer goods ones, among which there are those of the Innovac-Rima toy making with 105 applicants, the locksmith metallurgy with 35, Kemen industrial which dedicates to the manufacturing of office furniture with 21 or electric appliances manufacturing companies of companies which manufacturing small consumption: irons, laundry machines. With 25.72%, there are companies involved in mechanical and machinery engineering, worth mentioning Lipmesa with 35 applications dedicated to the manufacturing of shock absorbers or Gamesa with mechanical developments.

The third place is the 18.93% corresponding to process engineering where the company Arana Erana S.A. y Sagola S.A. is worth mentioning with 28 applications for paint equipment manufacturing. 8.67% corresponds to the electricity and electronic sector with the company *Celaya Emparanza y Galdós* as manufacturers of portable batteries

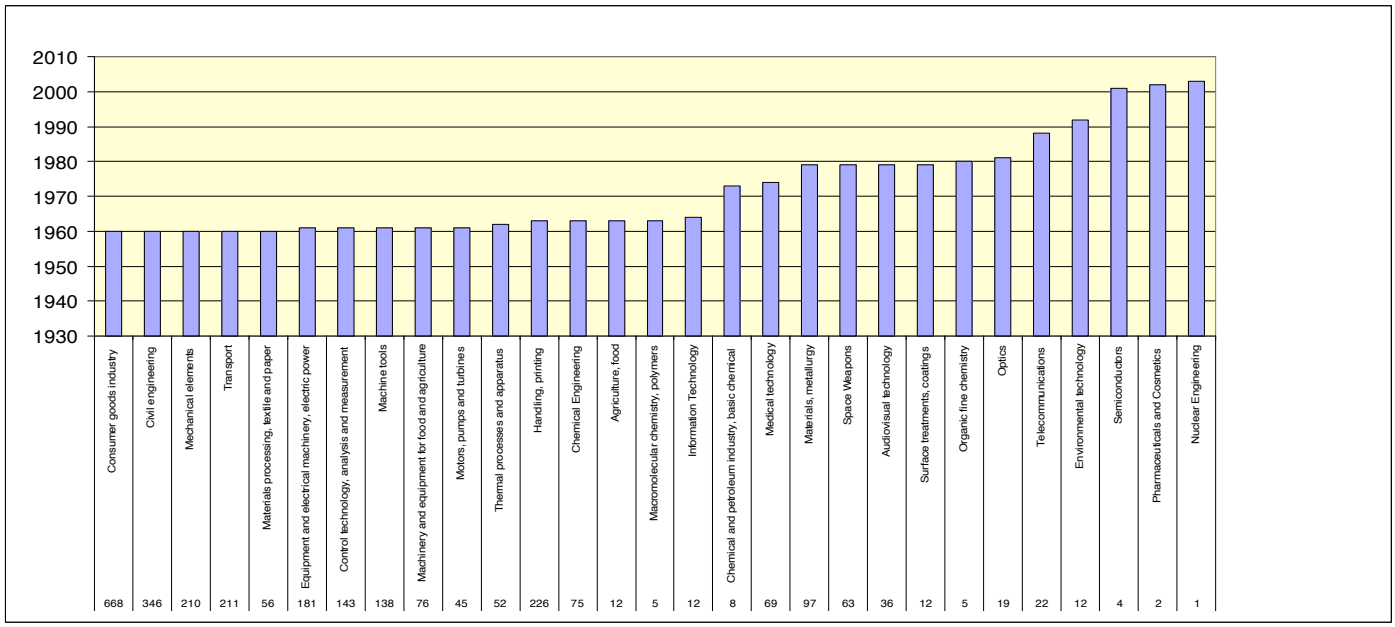

Fig 2. Evolution of the International Patent Classification

leading the sector with 38 applications. 8.14% corresponds to the instrumentation industry and 1.26% to the chemical and pharmaceutical industry.

We can appreciate the evolution of the innovative sectors in picture 3 along the years (1980-2006). Decreasing tendency of the three strongest sectors can be observed in the manufacturing of consumption goods and civil engineering, Machinery and mechanical instruments as well as process engineering comprising superficial treatments, material and metallurgy and materials processing in general.

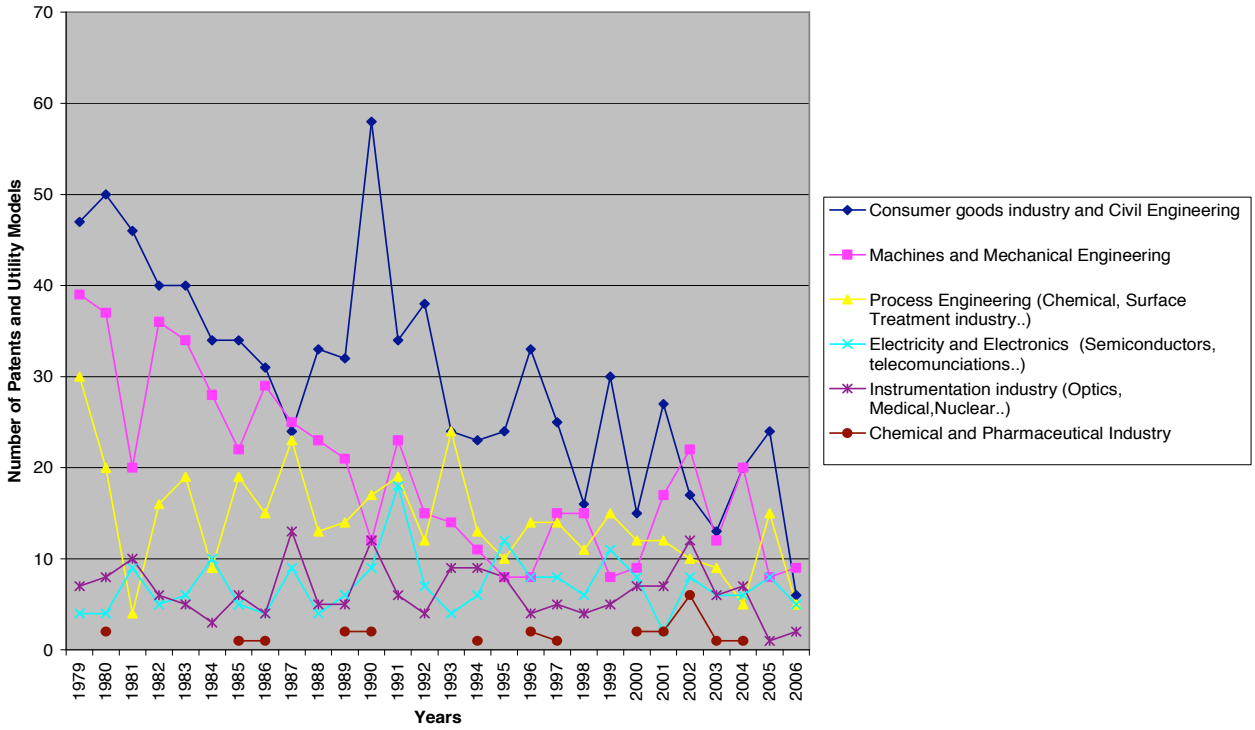

Fig 3. Industrial Sector Develop

V. *WHERE ARE THE INNOVATIVE COMPANIES LOCATED?*

The locations of the applicants are spotted in the figure 4 and their grouping around the industrial polygons of the region can be observed. It is important to note that the industrial polygons of Gamarra-Betoño 1 and 2, Arriaga, Aligobeo and Uritiasolo dating from 1950-1960 and surrounding the city of Vitoria-Gasteiz. However the polygons of Jundiz and Gojain are more recent 1970 and together with the Technology Park are located within a radius of 15-20 km from the city. Polygons Amurrio-Murga, Okondo-Llodio and Oyón are located in the province of Alava north and south.

By comparing the distribution and the number of innovations registered along the decades, (1960, 70. 80, 90, y 2000 and subsequences). You can view the evolution of industrial sites through the values of the registration of industrial property. So the polygon of Jundiz has highest rates of innovation in 1990, just twenty years after its creation and the older polygons such as Gamarra and Arriaga have highest rates in 1980, so just twenty years after its creation from which the indicator decreases. If this rule is met, we might expect high levels of innovation in the Technology Park by 2010.

It is worth mentioning the influence of the Technological Park created to diversify the industrial network of the region, fostering intensive industries as regards knowledge in the nineties, thus positioning with a 1% of the innovations applied for and in the years 2000-2006 already reaching a 17% of the innovations requested in the province.

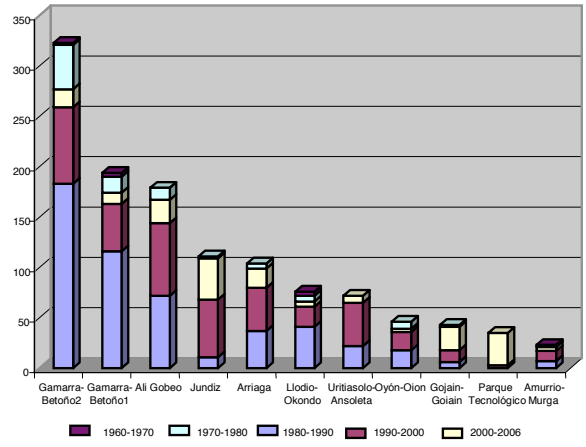

Fig. 4. Evolution of the innovation in the industrial polygons

VI. THE FUTURE OF THE REGION. PATENTABILITY EMERGENT AREAS.

The analysis of international classification of the patents requested along the sixties grouped by industrial sectors enables our visualizing of the most innovative industries of the region. A knowledge transfer can be appreciated from the traditional sectors which enter a maturity stage to other emergent and innovative sectors. If seen, through a cluster analysis carried out crossing the CIP and Date of application variables of the patent, we can identify in picture 5 three clusters:

Cluster 1. Years 80-90. Integrated by sectors: Information technologies, metallurgy materials, devices and electrical machinery, electrical engineering, printing, machinery and devices for food and the agricultural industry, consumption goods and equipment, superficial treatment, coating, control, analysis and measurement technology, thermal processes and devices, tool machinery, mechanical and motor elements, pumps and turbines.

Cluster 2. Years 90-00. Comprises patents requested by sectors such as: telecommunications, audiovisual technology, medical and optical technology. These sectors have developed their innovative activity, mainly, in the nineties.

Last but not least, Cluster 3. Years 00-03. This comprises very diverse sectors such as those of nuclear engineering, semiconductors and pharmaceutical and cosmetics products. Each of these sectors counts with a patent, applied for between the years 2000-2003, therefore, these are the innovative emergent sectors.

As a final note, if we update sample data to December 2007, the sample will be comprised of 2456 registrations, that is to say, there will be 159 new registrations with a distribution of 33% for patents and 67% for Utility Models, and this shows an advancement of patents when faced with models from the year 2006 to 2007. The emergent areas patent innovations beyond those of traditional innovation models.

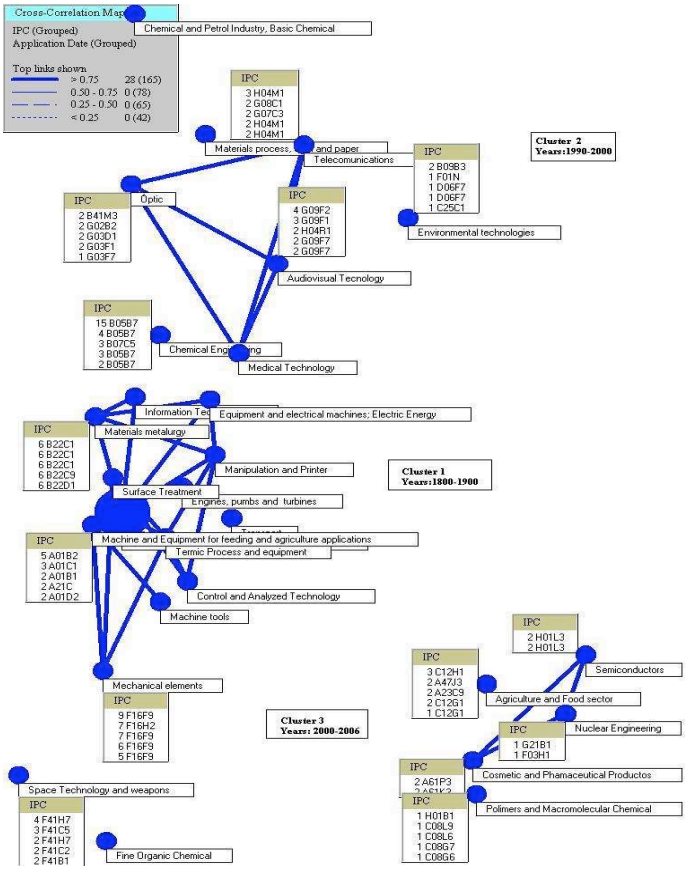

Fig 5. Patent emergent areas, Cluster analysis (IPC- Application date)

VII. CONCLUSIONS

On finishing the study, we can realize that the industry from Alava innovates and reflects so in the Application for Invention Patents and Utility Models. Innovation is in their greatest part, 70%, new at national level. The industrial sectors which have fostered Research and Development in the region of Alava have been (37,28%) those of civil engineering and consumption goods, (25.72%) mechanical engineering and machinery, (18.93%) process engineering, (8.67%) electricity and electronics, (8.14%) the instrumentation industry and (1.26%) the Chemical-Pharmaceutical industry.

Upon an analysis of the evolution of the sectors which have applied from 1960 to 2006, there has been a change in what we can call the "usability" of the patent, i.e., a change has taken place in areas of innovation from industrial process patents which gave place to end products to other areas where improvements to intermediate products are patented which are incorporated to the productive process, for example, the Alava Wrench (innovation of the so-called English wrench).

The innovative company from Alava does not export much technology, since only 3% of the patents applied for are issued internationally (PCT and Europe). Within this percentage, more than half (55%) is issued to countries of the European Union.

We can state that the patents requested are quite robust since their rejection in the Spanish Office for Patents and Brands is of only 8%. When the invention is registered, this is of great quality and new at worldwide level. Nevertheless, a reduction in the application of patents from the year 1979 to 2006 can be observed, and this shows that public administration measures towards fostering R&D have not been enough, public funds have been allocated to the maintenance of job positions but the generation of new knowledge and innovative actives has not been encouraged. The result is a decreasing tendency in R&D for the region. As regards the industrial polygons, a maturity is seen and their innovative capacity is flagging. In the last years, from 2000 to 2006, the technological Park comprises the most innovative companies in the region.

From the optimistic point of view, there is a final piece of news, 29% of the patents applied for and conceived are more than ten years old and correspond to sectors such as the semiconductors, telecommunications, pharmaceutical and cosmetics products, medical and optical technology ones. These sectors represent the engine of Alava.

We conclude that the records of inventions, utility models and patents databases, show the innovative potential of a region. Those analysis, facilitated by Tech-mining can serve as a diagnostic tool for prior R & D strategic planning and more importantly, as a good view of the dynamics of innovation in a region

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