VALUATING PATENTS GENERATED BY PUBLIC RESEARCH CENTERS WITH THE AHP TECHNIQUE.

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ABSTRACT

The technology transfer offices (TTO) of public research centers seek to support researchers who have developed patents of commercial value which may attract companies interested in exploiting them.

The problem faced by each institution's TTO is how to determine the value of those patents that could eventually lead to signing a satisfactory agreement between the institution and the company interested in the patent

The valuation of patents is a complex problem because it depends on the context the patent is developed and on multiple criteria associated with the knowledge area to which it belongs.

The main assumption of the present paper is whether the AHP method can be applied to help solve this problem, based on a previous experience in which the research group successfully applied the same approach to value tangible assets (properties, agricultural and industrial parcels, parks, ...).

The methodological approach presented in this paper will allow TTOs to optimize the techniques used to value patents and make this process more systematic, traceable and transparent.

Keywords: patent valuation, AHP

1.Introduction

In the knowledge era in which technology is developing rapidly the value of intangible assets has gained tremendous importance in recent years. Patents play a leading role among intangible assets as they contribute to value companies, give them more prestige and improve their R&D activities. However, patents are difficult to assess because they not only are one type of

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intangible asset, but are also a right (Lai and Che, 2009). According to Chen and Chang (2010), the competitive advantages of companies are now less frequently based on allocation of physical assets and increasingly based on intangible assets, such as patents. The task of assigning value to patent rights is particularly difficult (Harhoff et al., 2003).

In the past 20 years, academic researchers such as Narin et al. (1987), Trajtenberg (1990) and Hall et al. (2001), have developed several models that essentially aim at finding a proper weighting scheme for valuing patents, or the identification of the most promising patents in the vast ocean of encoded knowledge published each year by the major patent offices. Several empirical approaches have been used to estimate the value of a patent. They are based on data sets that cover different time periods and use different data sources. The functional architecture of these empirical models greatly varies. Some authors use the monetary value of the patents (Harhoff et al., 1999, 2003), their current value assigned by experts based on a scoring scale (Reitzig, 2003), patent citations (Lerner, 1994), a combined indicator (Lanjouw and Schankerman, 1999), the probability of obtaining a licensed patent (Guellec and van Pottelsberghe, 2000), patent opposition and data update (Pakes and Simpson, 1989, Lanjouw and Schankerman, 1999), if the patent develops a new high-technology or it is built on codified inventions (Shane, 2001). There are some more holistic approaches: (Sapsalis et al. 2006), focus in comparing criteria that define the value of academic and corporate patens and (Chiu and Cheng, 2007) use the AHP to asses a ranking of patents value to patents according to different criteria of different types. However, these authors did not assign a monetary value to the patents they analyzed.

This paper presents a model of patent valuation based on the AHP technique, the aim being to assess a monetary value by compering the problem patent with other patents whose market value is known.

AHP has been successfully used by the authors to evaluate real estate and intangible assets (Aragonés-Beltrán et al., 2008), (Garcia-Melon et al., 2008). The valuation model uses explanatory variables (evaluation criteria) and comparable assets (similar patents) to estimate the value of unknown new patents based on the AHP technique.

In the following the methodology used and the results of its application are presented.

2.Methodology followed:

The approach used to build the patent valuation model is as follows:

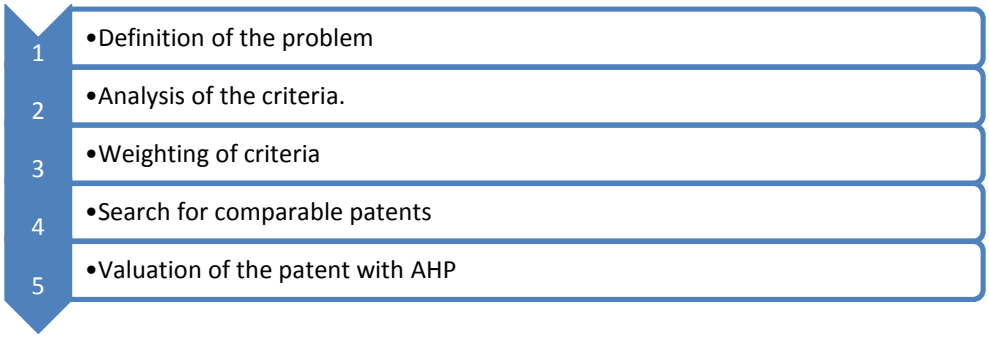

Figure 1. Methodology proposed

2.1.Definition of the problem

The aim of this work is to develop a patent valuation model based on the AHP technique. The model should be applicable to patents belonging to any technological field. The model uses explanatory variables (evaluation criteria) some of which were obtained from bibliographic sources and others upon the recommendation of the experts. The evaluation criteria must be

generic enough to be applicable to any kind of patent. For the valuation of each patent two similar patents with known and updated economic value are used as comparable assets.
For the development of the model the authors had the collaboration of expert patent evaluators from the UPV TTO (Technology Transfer Office of the Universidad Politecnica de Valencia) and from a Spanish patents and trademarks company.

2.2.Analysis of the criteria

2.2.1.Criteria proposed in the literature.

We are in a field of study that, although of a great importance in the world economy, is poorly researched. There are many possible approaches to address the problem. Additionally, there is a wide disparity in the terminology used for the valuation of patents in the literature. Below is a list of the criteria found in the literature and their source.:

Table 1. List of criteria obtained from the literature

criterion	description	source
Patent protection	This indicator refers to the scope of protection of the patent, i.e., the number of countries where it has been protected	Sapsalis et al.(2006)
Backward patent citations (BPC)	This indicator measures the technological knowledge of the patent, i.e., the number of backward patent citations. The greater the number of BPCs, the more valuable the patent is, and more so if the citations refer to patents from industry (higher market value).	Sapsalis et al.(2006)
Non patent citations	This indicator measures the scientific knowledge of the patent. It consists of the number of citations to scientific literature (e.g. research papers) containing the patent	Sapsalis et al.(2006)
Non self non patent citations	This indicator measures the number of citations of articles written by others (not by the inventor) that contain the patent.	Sapsalis et al.(2006)
Self non-patent citations	This indicator measures the number of citations of articles written by the researcher about his/her patent. Studies indicate that these citations add more value to the patent, as they show the experience of the researcher in the patent's field, and the likely commercial success of the patent.	Sapsalis et al.(2006)
Cooperation (Co-assignees)	A patent can have more than one inventor, they are called co-assignees. This criterion measures the number of co-assignees of a patent. To determine more accurately the value they bring to the patent, it is necessary to distinguish whether the co-assignees are from an industrial sector or a public institution	Sapsalis et al.(2006)
Corporate co-assignees	This criterion indicates that the co-assignee is from an industrial sector	Sapsalis et al.(2006)
Public co-assignees	This criterion indicates that the co-assignee is from a public institution. The patent is expected to have greater value if the co-assignees are from public institutions than if they come the industrial sector	Sapsalis et al.(2006)
Number of years a patent is renewed	It refers to the number of years that a patent has been renewed; it is an indicator of the value of a patent.	Sapsalis et al.(2006)

Monetary patent value	It indicates the economic value of a patent. It is a direct indicator of the value of a patent value, but it is difficult to know this value.	Sapsalis et al.(2006)
Forward patent citation	It refers to the number of citations of a patent in subsequent patents. Studies indicate that this indicator is closely related to the value of a patent. The greater the number of FPC, the greater the value of the patent	Sapsalis et al.(2006)
Age patent	The older the priority date (year of first presentation) of a patent is, the more likely it is to be cited in subsequent patents; the number of FPC will then be greater and consequently the patent will have greater value	Sapsalis et al.(2006)
Inventors	This indicator measures the number of inventors listed in the patent. It is necessary to distinguish the origin of the inventors, because in industry, the larger the number of inventors the greater the value of the patent, whereas in the academic sector it is the opposite, i.e., the fewer the members in the research group the greater the value of the patent.	Sapsalis et al.(2006)
Relative patent position	This criterion measures the number of patents a company has in its most important technological field (the area in which it has the largest number of patents), divided by the number of patents of the leader company in this field. With this criterion it is possible to determine the degree of specialization of a company in a particular technological field. The higher the RPP is, the higher market value the company will have..	Cheng and Chan (2010)
Herfindahl-Hirschman Index of patents	This criterion measures the degree of concentration of a technology company (between 0 and 1). If HHI equals 1, it means that all the company's patents belong to the same technological field, i.e., the company's technology is highly concentrated. The higher the HHI is, the lower the market value of the company.	Cheng and Chan (2010)
Reveal technology advantage	This criterion measures the budget allocated by a company to the patents belonging to a particular technological field divided by the budget allocated to all patents. The higher the RTA, the greater the relative strength of a company in a given technological field. However, studies show that the higher the RTA, the lower the market value of the company.	Cheng and Chan (2010)
Science linkage	Average number of citations to other references that appear on the cover of a patent, including journal articles and papers presented at scientific meetings..	Chiu and Chen (2007)
Technology cycle time	Average time (in years) of the youngest U.S. patents referenced on the cover of a U.S. patent.	Chiu and Chen (2007)
Current impact index	Number of citations generated by a company's patents in the last five years, divided by the expected number of citations of other comparable high-tech companies	Chiu and Chen (2007)

Number of IPC	It is a 4-digit number that is used to classify patents. This is a hierarchical system that divides technology into 60,000 categories; this number allows an estimation of the scope of the patent.	Harhoff et al.(2003)

2.2.2.Criteria proposed by experts

The assistance of two experts of a patent management company was required. They reviewed the list of criteria obtained from the literature, eliminated some of them and proposed new ones according to their expertise.

Table 2. List of criteria proposed by the experts according to their expertise

Patentability requirements	Patents are granted for new inventions which involve an inventive activity and are susceptible of industrial application
Fall-back options	One part of the application form for a patent is the descriptive report. The descriptive report supports the patent claims and provides a sufficient explanation of the invention so that a qualified expert in the field can reproduce it. The fall-back options are dependent claims that have a lower level of protection than the independent ones. The patent may be granted if the applicant renounces the independent claim and selects a preferred embodiment of the invention.
Divisional applications	If the patent office decides that the scope of the patent is too broad to be considered a single patent, it may be divided into a number of divisional applications that the applicant is free to present or not. The applicant can also file a divisional application at anytime
Relative patent position	Patent position in the group of patents covering similar material (i.e., which addresses the same technical problem).
Scope of the subject matter of a patent	The claims consist of a written report of the abstract inventive concept created by the inventor. They indicate exactly what the applicant considers his invention is. They set the outer limits of the protection of industrial property rights. There are of different types, products and processes (including applications and methods).
Triadic	This criterion refers to whether the patent has been filed simultaneously in the USPTO, JPO and EPO
Freedom of operation	The owner of the patent or any allowed person may freely exploit the patent provided there is no other patent in the State in which the patent is to be exploited that covers the claimed subject matter. In the event of the existence of other patents then it would be necessary to get permission for exploitation. Pending patent applications must also be taken into consideration .

2.2.3.Final model of criteria. Construction of AHP model.

At the end, a final list of criteria was proposed and a hierarchical model that included all the criteria considered important for the valuation of patents was built. These two same experts were necessary for the weighting of the criteria.

The criteria were arranged into groups in order to build a hierarchical structure.

Table 3. List of criteria

C1: Inherent features of the patent	**C1.1**	**Patentability requirements**
	C1.2	**Fall-back options**

	C1.3	**Divisional applications**
	C1.4	**Relative patent position**
	C1.5	**Scope of the subject matter**
C2: Patent strengths	**C2.1**	**Family size**
	C2.2	**Triadic**
	C2.3	**Litigations**
C3: Staff	**C3.1**	**Inventors**
	C3.2	**Self non-patent citations**
	C3.3	**Cooperation (Co-assignees)**
C4: Freedom	**C4**	**Free exploitation of the claimed subject matter**

The hierarchical structure built was the following:

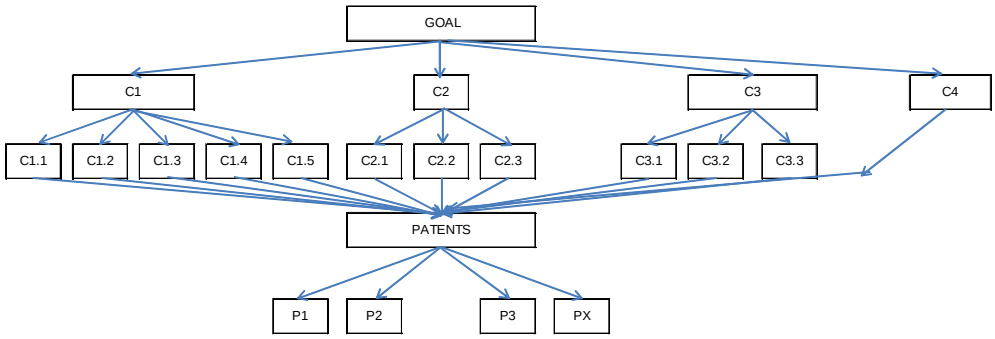

Figure 2. Hierarchical structure of the valuation model

2.3.Weighting of the criteria

Questionnaires based on pairwise questions for the priotitization of the criteria were developed and answered by the experts.

The resulting weights of the criteria are presented in the following table:

Table 4. Criteria weights

			local	**global**
C1: Inherent features of the patent (0,574)	C1.1	Patentability requirements	**0,49**	**0,281**
	C1.2	Fall-back options	**0,182**	**0,104**
	C1.3	Divisional applications	**0,044**	**0,025**
	C1.4	Relative patent position	**0,028**	**0,016**
	C1.5	Scope of the subject matter	**0,257**	**0,147**
C2: Patent strengths (0,178)	C2.1	Family size	**0,745**	**0,133**
	C2.2	Triadic	**0,156**	**0,028**
	C2.3	Litigations	**0,099**	**0,018**
C3: Staff (0,035)	C3.1	Inventors	**0,119**	**0,004**

	C3.2	Self non-patent citations	**0,747**	**0,026**
	C3.3	Cooperation (Co-assignees)	**0,134**	**0,005**
C4: Freedom (0,213)	C4	Free exploitation of the claimed subject matter	**1**	**0,213**

All the weights are calculated in the distributive mode.

2.4. Search for comparable patents

For this step, finding similar patents for use as comparables, we used commercial databases to access that information. We looked for patents in the same field of knowledge, whose selling price was known. That was probably the hardest part because data bases are of difficult access and also they provide scarce information. For the correct application of the methodology at least three comparable patents are required.

Our study analyzes a patent on a product that belongs to the field of **Sleep disorders**. Three comparable patents in the same field of knowledge and with recent economic transactions were used as comparables. The names of the patents and agreements are not shown due to confidentiality reasons.

Table 5. Data about the different patents analyzed

Name of the patent	N of patent license agreemement	Upfront fee	Royalty	Additiona payments	Total amount without approval	Total amount with all the approvals
P1	831	300.000	9	- 250.000 for NDA approval - mínimum of 250 for royalties	550.000	800.000
P2	18.511	2.500.000	7	-5.000.000 for NDA acceptation -10.000.000 for NDA approval -150.000 for the hospital when entering clinical tests phase II	2.650.000	17.650.000
P3	20.854	50.000	19	-3.000.000 depending on the product -10.000.000 for use is sleep manteinance -10.000.000 for NDA approval -5.000.000 for use label removal	13.050.000	51.050.000

				-3.000.000 forlabel against insomnia approval -10.000.000 label approval for use in sleep maintenance -		

2.5.Valuation of the problem patent with AHP/AMUVAM.

AHP will be used to prioritise and weight the reference patents and the problem patent.
According to (Aznar and Guijarro 2004) it is necessary to obtain a ratio that compares the weight of the problem patent with its market value. This ratio can be calculated as the quotient of the sum of all the market values of the reference patents, known by the valuator, and the sum of all their weights, obtained with the AHP.
The problem patent value can be calculated by multiplying the value/weighting ratio by the problem patent weight obtained with AHP. The valuator will have to analyse if this value is reasonable and makes sense in order to decide whether to accept it or to reject it.

The expert answered the questionnaires about the alternatives and values them according to the previously defined criteria.

The results are shown in the following table:

Table 6. Results of the values of the different patents

	AHP value	selling price of the patent (US$)	updated selling price (5% annual)(US$)	ratio
p1	0,345	800000	1583945	4591145,74
p2	0,213	17650000	17650000	82863849,8
p3	0,277	51050000	75424100	272289171
pX	0,165		**18704883**	

So, in this case, and according to the valuation method proposed in this paper, the Patent X should be sold for 18.704.883 US$.

3. Discussion and conclusions

In this paper the AHP has been applied to patent valuation. It has proven to be especially useful when data are only partially available, qualitative variables are used and influences among the explanatory variables are present. It can be adapted to any kind of patents, provided the explanatory variables and reference patents be correctly identified.

However, we want to emphasize that we have found that market values are not correlated with AHP values. That means that building a model only with technical criteria does not show the whole picture of the value of the patent. We conclude that it would be essential to take into account also the market-related aspects, which have not been analysed in this model. For that, this model does not substitute yet any of the previous mentioned models (Harhoff et al., 2003), (Sapsalis et al. 2006) but rather complements them.

We would recommend its use for rank ordering patents rather than for valuing them. The model provides a technological index for each patent which in term can be used to prioritize the patent portfolio of a company.

We can conclude, therefore, that the technical assessment of a patent is not enough to reach the market value. Our next step will be to combine the technical, market, legal and investment aspects in order to asses a more realistic value.

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