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Quantitative Approach for Decision Making in Engineering Intellectual Property Ownership Dispute

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ABSTRACT

Engineering research focuses in bringing new innovations in the market, especially in form of product. In order to protect from any infringement, the product need to be patented. The problem arises in later stage regarding ownership claim because involvement of many people in the research. The resolution process take a lot of time in several stages; issuing a dispute resolution, assigning panel dispute, attending session and hearing the panels decisions. This practice can be time consuming and unproductive. Thus, this paper focuses on the use of AHP application in engineering property ownership dispute. In order to do that, a decision making measurement (DMM) were developed by using the Analytic Hierarchy Process (AHP) approach. The DMM enable to determine the overall priority vector by calculating decision matrix of factors and the parties involved. Firstly, each factor has been quantified through the rank by the expert of this field. Then, the priority vector is computed for the factors as well as the parties. Finally, the result revealed that both party have their ownership indicates by the overall priority vector.

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INTRODUCTION

Advancement of our engineering research in the university level in Malaysia has widened the hope of science and technology to continue grows and compete with other countries in the world. In the engineering research, the researchers focus to bring new innovations that will help people in their daily routines. Most of the innovations are in the form of products and services. These products will bring benefit to the country as well as to the university. However, these products are vulnerable to the infringers and copycats from outside. The best way to keep and protect these products is to register for intellectual property protection under the Intellectual Property Corporation of Malaysia (MyIPO).

While registering the products, there are some issues arises regarding to the ownership of the products. In engineering research, most of the researches are conducted by collaborating with other organizations. The lead organization is the one who proposed the idea and collaborated with others who has technical advantages in the research. It happens when both parties tend to claim the ownership by themselves. The unwillingness to reach mutual agreement between parties does provide more disadvantages to themselves.

Those who feel biasness and unfair judgment of their rights, they seek resolution from the committees to solve the situation. Although the dispute resolution can bring some justification to issues, but the process of solving ownership dispute through a dispute resolution becoming more time consuming (Davies, E. and K. Chesworth. 2002). It is not as quick as thought. There are procedures to follow in order to solve the dispute, such as issuing a dispute resolution, assigning panel dispute, attending session and hearing the panels' decisions. To set up the discussion alone is very complicated because of other commitments in work. Large time consumption leads to additional cost and loss of opportunity for the IP commercialization. Settling the dispute quickly in the pre-commercialization stage would be benefit for parties in order to advance to other commercialization stage.

Although the decision has been made in settling the dispute, it may have a slight of biasness in the decision (Landsman, S., 2005). The result in selecting the right owner contains unconvincing and arguable decision. A subjective decision could be exploited by the other parties and lead to another dispute and cause more time. To

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solve this matter, we need some quantitative approach on the decision making for IP ownership in order to guide the process of selecting the right owner.

A quantitative approach for decision making could be the solution of this IP ownership dispute. Thus, this paper proposed a decision making measurement (DMM), an approach of using any kind of quantitative approaches that involves analyzing, calculating, quantifying and etc in determine the IP ownership. One of the quantitative application can be used is Analytic Hierarchy Process (AHP). Analytic Hierarchy Process is developed by Saaty, which divides a complicated system under study into a hierarchical system of elements. Pair-wise comparisons are made of the elements of each hierarchy by means of a nominal scale.

AHP also is designed to solve complex multicriteria decision problems (Anderson, D.R., 2007). It requires the decision maker to provide judgments about the relative importance of each criterion and then specify a preference for each decision alternative using each criterion. It also known as a theory of measurement through pairwise comparison in which the comparison is made using scale of absolute judgment (Saaty, T.L., 1980). AHP also has been used in determine selection of several decision making such as selection of supplier and many more (Nydick, R.L. and R.P. Hill, 1992).

This comparison based-scale technique using AHP help the decision maker to make the decision in determining the IP ownership by reducing complex decision to a series of simple comparison and rankings (Bevilacqua, M. and M. Braglia, 2000). The quantitative approach by using AHP are very useful as the model learned case by case for the purposes of developing a flexible decision making measurement for future IP ownership dispute.

Methodology:

The development of decision making measurement consists of four stages. The first stage is the identification of factors, which are extracted from the study of the real cases. The objective of finding the factors are to provide evaluation of all aspects of judgment could be made in solving the ownership dispute. Within these factors, the decision maker able to make a quick decision based on the contribution and priority of each research element. Second stage is construction of hierarchy graphical representation. With this hierarchy, the objective of DMM is become clearer. Third is the ranking process. This stage provides the ranking order of all factors based on the expertise's opinion. Last stage is construction of decision matrix. From this decision matrix, this study able to produce a value that determines the IP ownership for the right parties.

Identification of Factors:

In order to conduct this study, real cases are being reviewed in every aspect to extract information for this study. These aspects determine how well the DMM can produce the decision upon to solve the intellectual property ownership dispute. Using the available cases which is subjected to the privacy, the important ingredient in developing the DMM is to determine the criteria or the factors that contribute to the disputes issues. The DMM is operated based on the chronology and the situation of the cases, which involves quantification of the traditional verbal discussion among the parties for specific numbered and scaling data.

First of all, this study has analyzed the factors that contribute to the IP dispute through an interview with the expert field. The interview was designed to collect any factors and criteria that affect the decision in selecting the right owner of the intellectual property. Every factor selected must be consistently being the factors for all cases reviewed. It is because there are other factors that could be affected the disputes case in worldwide scenario, but not in current reviewed cases. Besides, extracting similar factors of each case enable for calculating and analyzing the same factors. This study has found the similar factors lies between all the cases and called it as Factor.

Set of factors = { $F_1, F_{2,\ldots,} F_n$ }

F_1 = Factor 1, F_2 = Factor 2, . . .

F_n = Factor of nth term

Other than that, this study determines the parties involved in every cases called Party. The lead party mentioned in the case will be the Party A and the remaining parties will be the next sequence. Using the information from the cases, there are two parties in each case disputing over the IP ownership rights.

Construction of hierarchy graphical representation:

The first step in AHP is to develop a graphical representation of the problem in terms of the overall goal, the criteria to be used, and the decision alternatives (Saaty, T.L., 1980). The first construction level of the hierarchy contains the overall goal is to select the right owner. At the second level, the six factors manoeuvre the selecting of the overall goal which each of the factor contributes to the achievement of the overall goal. Finally,

at the third level, each decision alternative representing the parties involved based on the cases, which contributes to each criterion in a unique way.

Ranking Process:

There are some problems when analyzing the data. Based on the survey conducted, the data for comparing the respective factors are presented in a ranking order. In the survey, the respondents have ranked all the factors through the order of priority. The sixth rank is the most important factor and the first rank is the least important factor.

Next, as suggested by Ramanathan (2001), the factors were compared in pairs in order to measure the importance among each other. This study has construct different scale of comparison between the factors, by choosing the difference between rank order of the factors. There are 15 pair of factors were formed from six factors, producing different value of comparison. These values of comparison provide a pairwise comparison between two factors and determine which have better value. Pairwise comparisons are used to represent the importance of each factor selected based on the decision-maker opinion on the factors chosen (Triantaphyllou, E. and S.H. Mann, 1995).

Let say C is the differences between the pairs. For example, the value of comparison between pair of factor 1 and factor 2 noted as $F_1 - F_2$ will be $C = R_1 - R_2$. The value of C must be in positive because of the comparison factor. The value of C is positive because of the absolute form, |C|. The value represents the weight of factors indicating the value of importance compared to other factors.

Another pairwise comparison is developed for the selection between the parties involved. These parties' pairwise comparison aim to choose which party is more preferable, by rating up based on the comparison scale.

Construction of Decision Matrix:

In order to determine the priorities vectors of six factors chosen, a decision matrix of the pairwise comparison ratings must be constructed. The computation of the decision matrix in using AHP is to calculate normalized eigenvector of the pairwise comparison matrix. From the decision matrix, the value represents the priority vector of each factor. Moreover, a second computation of decision matrix was constructed between the parties involved based on the comparison scale developed. This calculation determines the IP ownership right goes to which parties deserves.

The calculation of priority vector for each factor and the priority vector of the parties produce an indicator in the form of eigenvector which party has the weight in owning the intellectual property. The indicator enables to determine the ownership of the intellectual property. Following is the algorithm in computing the priority vectors.

First, construct a matrix pairwise elements. Matrix A is consists of value of comparison, C_{ij}.

$$A = \lfloor C_{ij} \rfloor$$

where $i = 1 \ldots 6$ and $j = 1 \ldots 6$

Second, sum the values in each column of the pairwise matrix as in equation (1).

$$C_{ij} = \sum_{i=1}^{n} C_{ij} \qquad \text{Eq.(1)}$$

where $i = 1 \ldots 6$ and $j = 1 \ldots 6$

Third, divide each element in the matrix by its column total to generate a normalized pairwise matrix

$$X_{ij} = \frac{C_{ij}}{\sum_{i=1}^{n} C_{ij}} matrix[A] \qquad \text{Eq(2)}$$

where $i = 1 \ldots 6$ and $j = 1 \ldots 6$

Finally, divide the sum of the normalized column of matrix by the number of factors used (n) to generate priorty vector of each factor.

$$W_{ij} = \frac{\sum_{j=1}^{n} X_{ij}}{n} \qquad \text{Eq(3)}$$

where $i = 1 \ldots 6$ and $j = 1 \ldots 6$

The priority vector of factors are calculated as $W_{ij} = \begin{bmatrix} W_{11} \\ W_{21} \\ W_{31} \\ W_{41} \\ W_{51} \\ W_{61} \end{bmatrix}$

where $i = 1 \ldots 6$ and $j = 1$

RESULTS AND DISCUSSION

A sample of 23 experts in the intellectual property management from different organizations completed the questionnaire. Using the information of the questionnaire, the respondents have compiled all six factors in the order of priority. The results of the priority order were shown in Table 1. It shows that factor 1, F_1 is the most important factors while factor 3, F_3 is the least important factor.

Table 1: Respondents' choice in selecting priority of the factors.

Factors, F_n	Factor 1, F_1	Factor 2, F_2	Factor 3, F_3	Factor 4, F_4	Factor 5, F_5	Factor 6, F_6
Rank order	6	5	1	2	4	3

All values of C_{ij} are calculated from the absolute differences between the paired factors. The complete pairwise comparison matrix as follows:

$A =$

	F_1	F_2	F_3	F_4	F_5	F_6
F_1	1	1	5	4	2	3
F_2	1	1	4	3	1	2
F_3	0.2	0.25	1	1	0.33	0.5
F_4	0.25	0.33	1	1	0.5	1
F_5	0.5	1	3	2	1	1
F_6	0.33	0.5	2	1	1	1

Fig. 1: Decision matrix of C_{ij}

The result of each factors' weight, W_{ij} were shown in Table 2. In order to determine which party will have more priority in the intellectual property ownership, the priority vector of each party for every factor, P_{ij} also were calculated. The result of the calculation as in Table 2:

Table 2: Weight of each party in accordance with factors.

Factor	Factors' weight, W_{ij}	Parties' weight, P_{ij}	
		Party A	Party B
Factor 1	0.315301	0.5	0.5
Factor 2	0.242799	0.2	0.8
Factor 3	0.063918	0.75	0.25
Factor 4	0.084391	0.8	0.2
Factor 5	0.17348	0.8	0.2
Factor 6	0.120111	0.333	0.667

The overall priority vector of this study can be calculated by $D = P_{ij} \times W_{ij}$

Overall priority vector, $D = \begin{bmatrix} 0.5 & 0.2 & 0.75 & 0.8 & 0.8 & 0.333 \\ 0.5 & 0.8 & 0.25 & 0.2 & 0.2 & 0.667 \end{bmatrix} \begin{bmatrix} 0.315301 \\ 0.242799 \\ 0.063918 \\ 0.084391 \\ 0.17348 \\ 0.120111 \end{bmatrix}$

$D = \begin{bmatrix} 0.500442 \\ 0.499558 \end{bmatrix}$

Fig. 2: Calculation of overall priority vector.

The result in Figure 2 indicates that party A and party B should be given equal ownership since the value are approximately to 0.5 for both parties.

Discussion:

From the beginning, the factors identified are the significant causes of the IP dispute were occured. This paper examines these particular factors to determine which parties have the upper hand on every factor. Logically, those who have greater contribution and efforts in the research will be given better weight on every factor. Each party has different proportion effort and contribution that they played as part of the research collaboration. However, each party has been given different value of weight by the expert field in selecting the owner of the IP. With six different factors, there are six value of weight imposed on the parties, which each party has different factor's weight depending on the expert decision.

From Table 2, it shows factor 1 inherit bigger value than others with 0.315301. It means the experts are favouring the factor one, F_1 as the biggest contribution to the decision. In factor one, the contents of the document in the early stages of research is the first thing they will evaluate on the dispute issue. As stated in the documents, the ownership should be given equally for both parties as they are agreed in the early stages. However, this factor sometimes is not used as indicator because of there is no agreement has been documented in early research. Then, this factor should be avoided when such thing is happened. Moreover, as in Table 2, the first factor weight imposed on each party is given by equal weight of 0.5. If in the document, the given ownership as stated was different, for example 60:40, then the applied weight should also changes into 0.6 and 0.4 respectively.

The overall priority vector provides value represent which party get more ownership and also provides value of each factor's importance. The decision, *D* of this study concluded that the results are completely similar as to the real result of the cases reviewed. The real cases have been given an equal ownership by the committees indicates that the system are well-validated and well constructed.

Lastly, the uses of Analytic Hierarch Process in the study certainly help the decision makers in selecting the right owners. It is a system that help reduces the time of decision makers by selecting the factors involved and giving appropriate weight to the factors. The overall priority vectors able to determine which party have more ownership than the others. It also shows that this qualitative are of study can be quantified in many ways in order to produce quality decision making.

Future Research:

In every case involving Intellectual Property ownership dispute occurred have different situation, thus contributing more factors to be considered compared in this paper. In the presence of more factors to be analysed, the system will be able to expand its usefulness with another IP ownership cases. In order to develop more flexible system towards new cases, we have to train the system with new cases and analyzing each of the relevant information to be accounted as factors. Furthermore, the usage of more IP ownership cases are recommended in further research and also a lot of respondents are needed in developing an effective comparison scale to improve the system.

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