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運用模糊方法來遴選臺灣智慧財產權管理專員

Using Fuzzy Evaluation and Screening of Managers of the Intellectual Property Rights Speciality in Taiwan

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摘要

本研究運用模糊德菲法與層級分析法兩個步驟來建立準則，遴選台灣的智慧財產權專業管理人員，並分析使用兩種方法後所穫得之遴選關鍵因素。產業通常能夠運用自身的關鍵資源以贏取競爭優勢機會來擴大其全球市場，本研究評選委員來源為從事與智慧財產權相關背景的產、官、學者專家共有 29 位參與；經由兩階段步驟來建立準則，研究結果發現到遴選智慧財產權專業管理人員的五個關鍵能力因素，分別是：具有評價智慧財產權能力者，具備精專找尋核心專利群能力者，具有評估專利可以釋出的可行性能力者，精估授權最適當時機能力者，決定專利應用於過內外之能力者。本研究發現可供遴選適才適所、智慧財產權專業人員研究參考。

關鍵詞：層級分析法、遴選、關鍵因素、智慧財產權管理者、模糊德菲

Abstract

This research uses the fuzzy Delphi screening criteria and Analytical Hierarchy Process (AHP) to analyze the key factors involved in evaluating and screening industry managers of intellectual property (IP) rights within Taiwan. Firms can utilize key human resource management factors to provide self-growth opportunities and obtain competitive advantage opportunities that can expand their global market share. This study summarizes the evaluation and screening criteria used for IPR managers via a questionnaire distributed to 29 management experts, government workers in IPR-related departments, and scholars with backgrounds in IPR related teaching; all had actually participated in IPR manager specialty decisions. The findings indicate five key competency factors: evaluating IPR, locating the core patent group, calculating the chance that patents will be granted, deciding the best time to patent, and deciding whether to apply for patents inland or

overseas.

Keywords: Analytical Hierarchy Process, Evaluation and Screening, Key Factor, Intellectual Property Rights Managers, Fuzzy Delphi

1. INTRODUCTION

Intellectual property (IP) rights are invisible properties, differing from tangible possessions not only in their ways of usage but also their evaluation. As the world's economy is gearing toward becoming a knowledge-based one, knowledge workers hold the key to IP rights (the creations of minds). Hence, there arises a brand new management task: how do companies turn their employees' knowledge into their intellectual property? Intellectual property has become an important source of income for enterprises and IP rights management has now turned mainstream in management. Through management of IP rights, enterprises not only can protect the hard-won research results and relevant intellectual properties being infringed upon but also turn it as a weapon in competition for promoting booming development of the entire industry and accumulate national competitiveness.

With the society becoming ever more knowledge intensive, the prosperity of a company depends increasingly on a systematic integration between IP rights and R&D results. This call patent, patent is and exclusive right granted for an invention, which is a product or a process that provides a newway of doing something, or offers a new technical solution to a problem (http://www.wipo.int/about-ip/en/patents.html). As the link between IP rights and profit is proven to be positive, managing IP rights naturally becomes a crucial aspect of business strategy.

The technology service providers for IP rights work in an interdisciplinary way to deal with issues of management, legal affairs and technology. Currently, in Taiwan, IP rights management is widely acknowledged to be one of the most

important topics by industry, the government and academia alike. Facing the present economic climate, in which innovation and knowledge capital are deemed to be of great significance, companies should take immediate action to promote research and innovation, as well as the effective management of IP rights. This naturally leads to the increasing demand for talent in the field of IP rights management.

The core of IP rights management is the search for suitable talent, as successful management is decided by various factors, both internal and external. To overcome the internal challenges, professionals form legal, technological and managerial back-grounds have to collaborate. The shortage of talent at the moment is a direct result of the small number of training organizations and staff. Therefore, how to cultivate the most needed talent is currently a pressing issue for IP rights management. However, few quantitaltive studies have focused on the selection of IPR management personnel or assessed the required skills(specialties) for the IPR workforce. The only source of information to shed light on the current state of the industry is interviews. In Taiwan, there are simply not enough qualified personnel to meet the existing demands for IPR specialists due to a lack of training courses, which at the moment are provided by only a handful of graduate schools. With the limited availability of quality training, it is difficult to improve the overall quality of the IPR workforce. In an attempt to identify the required specialties of IPR staff, this study was conducted qualitatively, following the concept of competence analysis. In-depth interviews with industry experts and questionnaire surveys were also included. The competence in dices and weights of varied “specialties” were measured via Fuzzy Delphi and AHP.In comparison,there is insufficient quantitative research focusing on the selection of IP rights management personnel.

Within the present economic climate, in which innovation and knowledge capital are deemed to be of great significance, companies must take immediate action to promote research and innovation, as well as the effective management of IPR. This naturally leads to the increasing demand for talent in the field of IPR management—professionals who are able to provide technological development forecasts and carry out the procedures of patent registration and technology

commercialisation.

However, few quantitative studies have focused on the selection of IPR management personnel or assessed the required skills (specialties) for the IPR workforce. The only source of information to shed light on the current state of the industry is interviews. In Taiwan, there are simply not enough qualified personnel to meet the existing demands for IPR specialists due to a lack of training courses, which at the moment are provided by only a handful of graduate schools. With the limited availability of quality training, it is difficult to improve the overall quality of the IPR workforce. In an attempt to identify the required specialties of IPR staff, this study was conducted qualitatively, following the concept of competence analysis. In-depth interviews with industry experts and questionnaire surveys were also included. The competence indices and weights of varied "specialties" were measured via Fuzzy Delphi and AHP (Table 1). According to their fuzzy weight values, 16 of 22 sub-indices were selected to construct the research model depicted in Figure 1. From this model, five criteria were then selected as key factors according to their relative weights (Tables 5 through 7).

To address the present dearth of information regarding these issues, the current study is designed with the following aims in mind:

(1) establish the relative weight and deciding factors that pertain to the vetting of IPR managers;
(2) offer concrete suggestions for the training of IPR managers; and
(3) provide information for aspiring IPR managers about the requirements of IPR management as a profession.

2. LITERATURE REVIEW

2.1 Managers of IPR Specialty Competency Index

The online Taiwan technology market trading platform (www.twtm.com.tw) was originally launched by the Industrial Development Bureau of the Ministry of

Economic Affairs (2009a). According to their website, services related to IPR management fall under five categories: 1) services to establish IPR management and implementation systems; 2) services to increase the value of IPR; 3) services that assist in IPR evaluation; 4) IPR legal services; and 5) services to plan and implement IPR, R&D results and corporate strategies, as well as IPR integration, education and training. These categories not only highlight the responsibilities of IPR managers, but also their significance to the industry. Effective management is able to bring forth tactical correlations among internal IPR holders in a way that boosts the firm's strategic operations and competitive edge.

In recent years, the technology industry in Taiwan has made promising advances in its R&D capability. However, this trend has also led to an increase in the number of IP infringement lawsuits raised by international companies. Even one missed step in the patent application process often proves costly. In most cases, a lack of IPR management can be blamed for this, in combination with companies' inadequate awareness of IPR protection. As such, technology companies should consider employing IP rights management professionals to enable smooth technological integration, including technology transfer and evaluation, investment assessment and technology management.

In terms of IP rights, managers must possess the expertise and ability to protect innovations and new applications through their training in legal fields such as patents, copyright, business privacy and trademarks (Hwang, 2005). Intellectual property rights managers should develop their capability in related fields and research units to better forecast technical developments, as well as become more informed about the patent application process and technical merchandizing, in order to promote the significance and importance of IPR (Xu, 2003).

Further, IPR managers are in high demand in the current marketplace within Taiwan. However, there is presently a lack of trained professionals available to assist companies. In other words, talent cultivation has become the most pressing issue for both the authorities and IPR service providers. As such, the current study is significant, in that it pertains to the current climate and the current needs.

The literature review adopted the concept-competency analysis approach, suggested by Webster & Watson (2002) in MIS Quarterly, to cover the following

three subjects: professional competency, basic competency and personality. Pioneered by Catano (1998), these three concepts have been explored by other researchers and their effectiveness confirmed (Spencer & Spencer, 1993). This research adapted the 22 sub-indices proposed by Catano (1998) (Table 1), and through a process of expert evaluation reduced the number to 16 (Figure 1). These 16 indices were then marked accordingly, with the top five (with the highest scores) identified as key factors.

2.2 Tasks for IPR professionals

This study defines IPR as a combination of serial wisdom formed from human ideas, achievement-based creativity, and tangible and intangible values. Moreover, others cannot own or practice IPR by improper means (Chen et al., 2009). Chen et al. (2009) further point out that tasks for IPR professionals include:

(1) IPR audits – active discovery of internal patent-valued technologies and the subsequent application proposal.

(2) Patent information collection – includes patent map and design around. The former systematically sorts existing patent documents and data to present competitor information in graphs; the latter expels applying technologies from current rights.

(3) IPR maintenance – patent registration, regular updates, payments for annual fees and renewal.

(4) Patent protection – dealing with legal issues surrounding corporate patents.

2.3 The Meaning of Competency

Further, a pragmatic worker should know how to integrate his/her professional knowledge with that of his/her colleagues. Therefore, when evaluating an individual's professional competency, situational and human factors cannot be overlooked (Queeney, 1996). Apart from work competency (Spencer & Spencer,

1993), there is also generic competency (Waugh, 1990; Catano, 1998; Coomer, 1998; Virtanen, 2000), which is a general ability that can be applied to more than one specific position or discipline—potentially even to every position, department or class within an organization (Catano, 1998). Waugh (1990) proposes that basic work competences include listening, reading, communication, teamwork, self-management and self-motivation. According to Coomer (1998), reading, communication, computing, data searching, problem solving and team work should all be included in the range of work competences. Based on the above, competencies include the visible and underlying attributes required for the accomplishment of a task. Moreover, performance is closely related to the level of competency and can be assessed and ameliorated via training. Catano (1998) provides an unambiguous explanation of the task competencies needed for IPR specialists, which were adopted by Chang et al. (2007), Hwang (2005), and Zhao & Huang (2004). The current study adopts Catano's definition of competence to look at the competences involved in IP management from three aspects: professional competency, basic competency and personality (Catano, 1998).

(1) Professional Competency

Professional competency refers to the knowledge and skills required for the execution of a profession. This aspect of competency belongs to the visible attributes of the iceberg model (Spencer & Spencer, 1993). With reference to the IP management services listed on the Taiwan technology market (Ministry of Economic Affairs, 2009b, 2009c), this study concludes that there are six sub-indicators of professional competency,including patent inventory, locating the core patent group, applying patents inland and overseas, evaluating IP rights, deciding on the best timing to apply for the patent, and calculating the chance of the patent being granted.

The selection of IPR management specialists should be based on their technological expertise and their familiarity with legal regulations and laws, which can ensure the proper development of the six indicators in the related professional fields.

Intellectual property refers to a number of distinct types of legal monopolies over creations of the mind, both artistic and commercial, and corresponding fields of law such as patents, trademarks, copyrights, business privacy, IC designs and the ownership of those monopolies. Since specialists need to provide such IP related services to clients, it is important for them to have strong personal communication abilities to secure cooperative business behavior and relationships with all levels and types of industry.

This study refers to the hierarchical structure of the inscriptive IP services industries from the Taiwan Technology Marketplace of the Industrial Development Bureau (2009b) of the Ministry of Economic Affairs, Taiwan. For those industries, a total of nine sub-indicators were chosen: the six aforementioned sub-indicators of professional competency, in addition to various experts' choice of expertise, general competency, and personal traits.

(2) Basic Competency

Basic competency refers to an ability that can be applied extensively to any work situation and also one that can act as an aid to the expression of professional competence (Coomer, 1998). In this study, the five basic functions of IPR professionals as proposed by Chang et al. (2007) are used as sub-indicators: observation competence (Hwang, 2005); data collection competence (Coomer, 1998; Hwang, 2005); communication and coordination competence (Schermerhorn et al., 1988; Coomer, 1998); problem-solving competence, and English proficiency competence (Waugh, 1990; Hwang, 2005). "Competency Index Construction for Employees of the Intellectual Property Technology Service Industry", are visit business in industry specialty**,** managerial from IPR-related industries.

(3) Personality

Personality refers to a combination of individual characteristics and behaviors that promote excellence in work performance. These are the underlying features in Spencer & Spencer's iceberg model (Spencer & Spencer, 1993). This study referred to the work of Chang et al. (2007) to list five personality-related features

as the sub-indicators of personality.These are also based on industry services, and include: professional confidence, a sense of responsibility, a sense of morality, an ability to adapt, and team spirit (Wood & Payne, 1998).This study meaning of competency(basic competency & personality)all referred to the work of Chang et al. (2007) to list the management of intellectual property rights speciality 3 structure competency index as.

3. Methodology

3.1 Structure

Because each evaluation criterion in this study is qualitative in nature, they are difficult to quantify for practical application. Therefore, this research deployed a two-stage expert questionnaire to establish the criteria for evaluating and screening the IPR specialty managers. In the first stage, we used a fuzzy Delphi method to screen the relevant influential factors and utilized the concept of a threshold value to select the proper evaluation criteria. In the second stage, we utilized evaluation criteria obtained from the screening, fitting and analytical hierarchy process, to obtain the relative weight of the evaluation criteria. The hierarchical structure is shown in Figure 1.

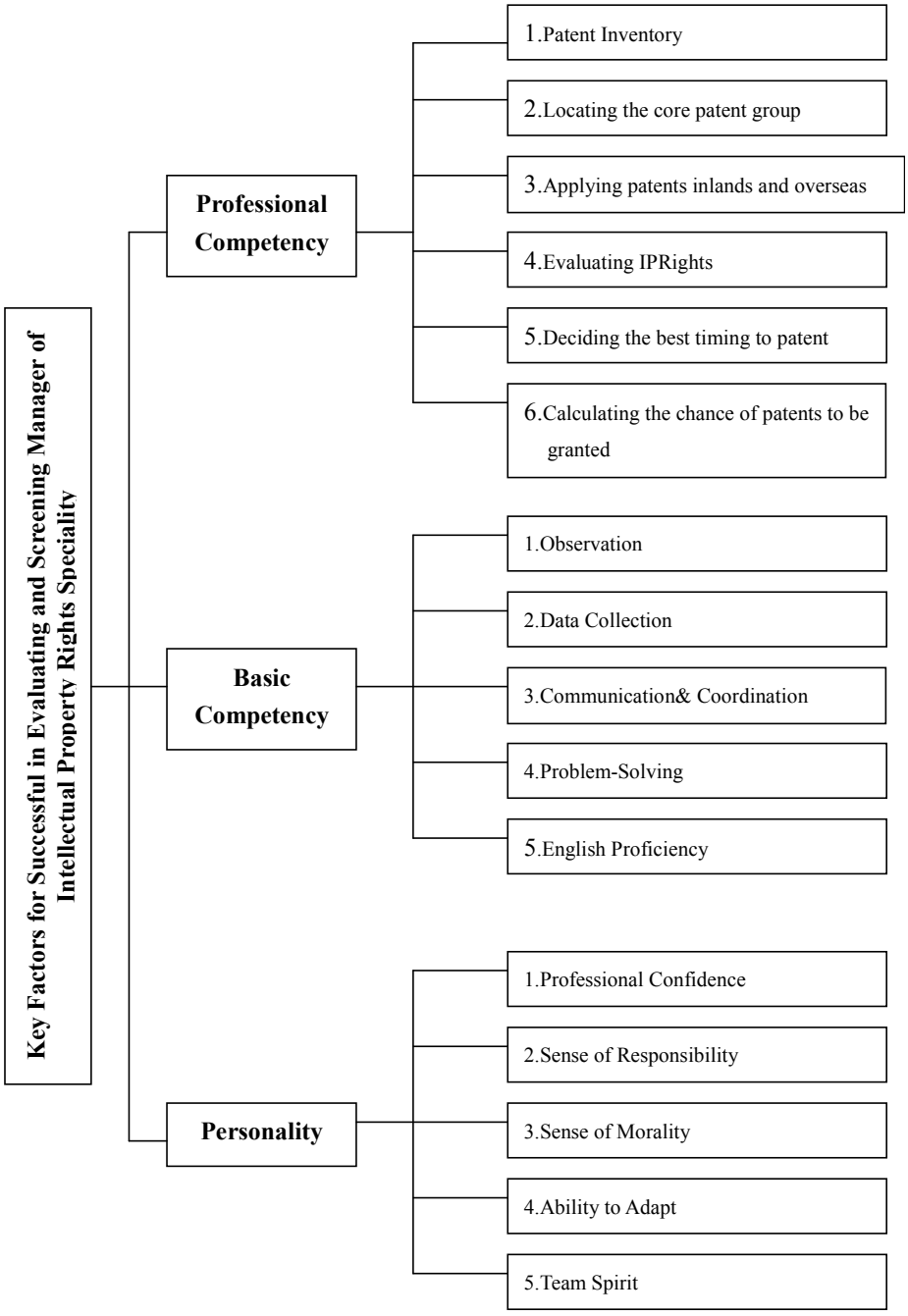

Figure 1. Research Model

3.2 Questionnaire Design and Analysis

Since the selection criteria in this research are descriptive, it is difficult to quantify them. To overcome this problem we adopted the two-stage expert questionnaire from Hwang (2005). The questionnaire analysis mainly consists of a fuzzy Delphi method and an analytical hierarchy process. The first stage of the questionnaire explores expert opinions, so we used the fuzzy Delphi method to sieve the factors and to tie in the concept of the threshold number to choose suitable selection criteria. The items that resulted from summarizing the geometric means of the aforementioned items in the literature review and reached the threshold value for each dimension were used as the basis for development. The second stage questionnaire was mainly based on the results of the first stage in terms of building a hierarchical structure; it deployed pair-wise comparisons, conforming to the application of rating scales. We employed the Fuzzy Analytical Hierarchy Process (AHP) to evaluate the relative weight of each criterion.

This research focused on a wide variety of participants in industry, government, and academia, including executives who are actually responsible for managing IPR specialty tasks in these three areas. A total of 40 questionnaires were sent out on March 20, 2009, with a response deadline of April 10, 2009; 29 valid responses were received by the deadline, for a response rate of 72.5%.

3.2.1 Implementation of the expert questionnaire

The objective of the Delphi, or expert, questionnaire was to sieve the most significant selection criteria from the 22 criteria listed above. The resulting criteria formed the basis for ordering the alternatives. The surveys were distributed the 10 of March 2009 and retrieved about one week later. We chose to survey people from the three largest branches revenues at the managers of intellectual property rights specialty tasks level. The result was 29 valid expert questionnaires, with an equal response from each of the three divisions.

We sieved out principles and 16 selection criteria items before proceeding to subsequent steps. This study used the fuzzy Delphi method and AHP to collect the findings of experts to simplify the former 22 secondary distribution transfers into

16 secondary regulations. The purpose was to establish the next step in the AHP research method to build the hierarchical structure. Steps 1 and 2 were both useful. Compared to other operational occupations, IPR management is a newly emerging industry. Competency analyses needed to be applied when interviewing industrial experts where data is to be used while conducting advanced level interviews with them. Further, industrial ability indicators had to be collected and analyzed in order to design a survey for the 29 experts.

The expert survey was based on the following criteria: (1) IP departments surveyed had to be in service-oriented industries, and had to have been operating for at least three years, (2) experts must have had at least five years of management experience in government departments, (3) university faculty had to teach IP related courses, and (4) experts had to be willing to participate in interviews and complete surveys.

3.2.2 Saaty's AHP weighting

Expert choices served as the basis for calculating each criterion's relative weight. Next, the sample was tested using the consistency index. Since the resulting values from the sample were all less than 0.1, they all met the threshold criteria and were classified as valid responses.

3.2.3 Pair-wise Comparison Matrix of relative weight values

The expert evaluations might have varied across multiple operating environments, which could have easily introduced bias into the weighting process. Thus, the bias-prone factors were removed to make the analysis more impartial and objective: a simple analytic hierarchy process was applied to obtain a result for each criterion. In order to calculate the Pair-wise Comparison Matrix of relative weight values (see Tables 3-6).

AHP was used to retrieve the expert majority opinions and deploy pair-wise comparisons to find the relative importance of the decision elements; it also helped in the selection of the largest relative weighted scheme as the best scheme by linking the hierarchy levels.

3.3 Delphi and Fuzzy Theory

The Delphi method was developed by the RAND Corporation in the early 1950s, where it was primarily used to handle complicated national defense problems. Now incorporated into group decision methods, the Delphi technique facilitates the incorporation of expert opinions. The objective of the technique is to obtain a common consensus among various experts about the future incidence of the issue under study. In this manner, the collective wisdom and all useful ideas are integrated into a higher quality of expressed judgment.

However the technique must be iterated until the expert opinions tend to unanimity. Figure 2 shows the objective of the traditional Delphi Method, where the gray area (a, b) represents an acceptable decision range (Hsu, 1998).

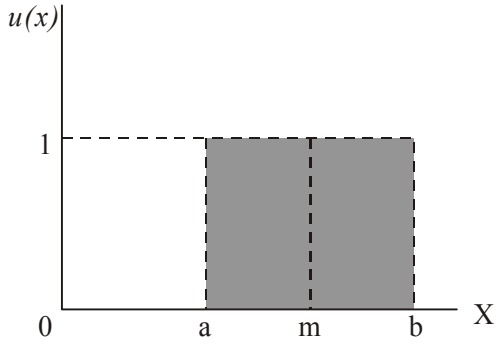

Figure 2. **Traditional Delphi Method**

The process of querying expert opinions included asking them to modify their answers after reviewing the previous results. If the medium number of the resulting opinions fell within the range provided above, this was considered as a tendency to unanimity. However, this process can be time consuming and not entirely effective. To overcome some of these shortcomings, we also incorporated the Fuzzy theory.

Fuzzy Theory was developed in 1965 by L. A. Zadeh, a professor in the University of California, Berkeley. The theory was an outcome of his research into the human subjectiveness or thinking processes. Fuzzy Theory draws on the vague

information derived from subjective performance opinions to arrive at a quantitative processing model. Traditional experimental controls involve the use of accurate mathematical models. In this situation, though, it is both difficult and time consuming to establish a model due to the absence of definitive measures. In order to try to solve these problems and achieve traditional control objectives, Zadeh advocated the use of Fuzzy Theory.

Ishikawa et al. (1993) compared the traditional Delphi method with fuzzy Delphi and identified the following advantages: reduced investigation time, more complete expression of expert opinions, and greater consideration of unavoidable fuzzy problems in the process of investigation. Murray et al. (1985) tried to use Fuzzy Theory with the Delphi method, and considered the answers from their Delphi questionnaire to be fuzzy. In turn, they suggested the use of a linguistic variable to solve this problem.

3.3.1 Application of fuzzy Delphi

Hsu & Yang (2000) encompassed expert opinions using the Triangular Fuzzy Numbers to establish the fuzzy Delphi method. Expert opinion maximums and minimums separately form the two ends of Triangular Fuzzy Numbers; using a geometric means to act as a mean of the Triangular Fuzzy Numbers Property will avoid the influence of extreme values and thereby achieve a better effect as compared to the standard selection.

A major advantage of the fuzzy Delphi method for group decision-making lies in taking individual expert opinions into consideration for a better integration; furthermore, a consensus from group decision-making can be accomplished. This method is better able to generalize all uncertain information from arbitrary presumption other than solving for the ambiguity of human thinking; furthermore, it can decrease investigation times, and reduce duration and expenses.

The accessible Intellectual Property services from the Taiwan Technology Marketplace network (Industrial Development Bureau, 2009a) from the Ministry of Economic Affairs lists a directory of registered manufacturers that also includes the professional skills that comprise the nine sub-indexes of professional skills. This research provided the 29 experts with such indexes for reference and discussion, as

shown in Table 1. Three of the nine sub-indexes were not evaluated by these 29 experts for converted scores due to their low geometric means: the competency of providing design-around opinions, identifying patent technology, and developing R&D strategies for enterprises by patent analyses. The remaining six professional skill indexes stress patent management. One of the basic competency indexes, generalizing and analyzing, was not selected by experts. Two of the personality factors, aggressively and enthusiastically showing off, were not selected, either.

Table 1. Fuzzy Weight Value of Each Criterion

Criterion	*Sub-criterion*	*Geometric mean*	*Sort order*
C11	*Patent inventory*	*0.296*	***1***
C12	*Locating the core patent group*	*0.208*	***4***
C13	*Applying for patents inlands or overseas*	*0.196*	***5***
C14	*Evaluating IPR*	*0.288*	***2***
C15	*Deciding the best timing to patent*	*0.264*	***3***
C16	*Calculating the chance of patents being granted*	*0.156*	***6***
C17	*The competency of providing design-around opinions*	*0.092*	*8*
C18	*Identifying patent technology and developing R&D strategies for enterprises by patent analyses*	*0.076*	*7*
C19	*Identifying patent technology*	*0.068*	*9*
C21	*Observation*	*0.092*	***5***
C22	*Data collection*	*0.103*	***3***
C23	*Communication & coordination*	*0.112*	***2***
C24	*Problem-solving*	*0.118*	***1***
C25	*English proficiency*	*0.098*	***4***
C26	*Generalizing and analyzing proficiency*	*0.082*	*6*
C31	*Professional confidence*	*0.066*	***5***
C32	*Sense of responsibility*	*0.108*	***2***
C33	*Sense of morality*	*0.116*	***1***
C34	*Ability to adapt*	*0.092*	***3***
C35	*Team spirit*	*0.080*	***4***
C36	*Aggressiveness*	*0.054*	*6*
C37	*Enthusiastically showing off*	*0.042*	*7*

3.4 Analytic Hierarchy Process (AHP)

Due to rapid environmental changes, the aspects considered by decision makers have become more complicated and varied. In order to solve this problem, Saaty (1980) proposed the Analytic Hierarchy Process (AHP) as a systematic decision making model. AHP can assist decision makers to take account of quantitative and qualitative factors when they face complicated and divergent problems. The more weighted value the scheme has, the higher the priority for scheme adoption. AHP can be used to reduce the risk of making bad decisions and to help the decision makers to make sound judgments (Tsang, 1998).

3.4.1 Use of the Analytical Hierarchy Process (AHP) method

Daw (1993) noted that when people use the AHP method:

(1) the items in the same layer must have high independence;

(2) the items are cross-compared up to seven to nine;

(3) the results of the cross comparison analysis can be tested using sensitivity analysis; and

(4) the geometric mean should be used for the cross comparison of numbers when a small group uses AHP.

Some of the early research behavior was considered to involve a special result—behavior was a result of motivation that led to a particular incident. In an active process with goals, the order becomes motivation, incident, and result. Consequently, behavior is not completely equal to the incident in AHP. The system participant behaviors control the incident result, and they can choose the beneficial modes that they want.

3.4.2 Analytic Hierarchy Process (AHP) Steps

The AHP procedure can be divided into nine steps as outlined below:

(1) Define the decision problems

When using AHP to evaluate the hierarchy of key factors, the direction of the problem must be fully grasped. First of all, the problem must be clarified, and the scope of the problem must be clearly defined.

(2) List every evaluating factor

When listing every evaluating factor, the relevant literature, group brainstorming, and Delphi methods are used, as well as the professional knowledge and practical experience scholars and experts.

(3) Develop the hierarchy structure

Every evaluating factor is compartmentalized into a hierarchical layer according to the relevant relationships of each factor and their independence level. Saaty (1980) suggested that each layer should have no more than seven items in order to avoid conflicts that may affect the evaluating results.

(4) Conduct pair-wise comparison and evaluation

Pair-wise comparison is conducted according to the relative importance of each evaluating factor. This can lighten the decision makers' burden in terms of thinking; it can also more clearly present the relative importance of the decision factors. AHP employs a nominal scale as the evaluating indicator of pair-wise comparisons, which can be divided into nine scales, as shown in Table 2:

Table 2. AHP Scale Definitions and Explanations

Evaluating Scale	Definition	Explanation
1	Equal Importance	Contributions of two criteria are equally important
3	Weak Importance	Experience and judgment moderately favor one scheme over another
5	Essential Importance	Experience and judgment strongly favor one scheme over another
7	Very Strong Importance	In practice, one scheme is favored very strongly over another
9	Absolute Importance	Experience and judgment favor one scheme over another
2, 4, 6, 8	Intermediate Values of Neighborhood Scales	When compromise judgment values are needed

Source: Saaty (1980)

After summarizing the evaluator opinions, we evaluated the items via a nominal scale to produce proper comparison values. In general, a geometric mean served as a basis for forming the comparison matrix.

(5) Establish a pair-wise comparison matrix

When conducting pair-wise comparisons for *n* elements, *n (n-1)/2* comparisons are needed. We put the measure of the comparison results for *n* elements into the upper triangular part of the comparison matrix, while the bottom triangular part served as the reverse value of the upper triangular part's relative value. As such, we obtained pair-wise comparison matrix A, shown in Equation (1):

$$A=\begin{bmatrix} 1 & a_{12} & \Lambda & a_{1n} \\ 1/a_{12} & 1 & \Lambda & a_{2n} \\ \mathrm{M} & \mathrm{M} & \mathrm{O} & \mathrm{M} \\ 1/a_{1n} & 1/a_{2n} & \Lambda & 1 \end{bmatrix} \qquad (1)$$

where a_{ij} denotes the relative importance of element *i* as compared with element *j*.

(6) Find the eigen vector and maximized eigenvalue

Saaty & Vargas (1982) proposed four approximate eigen vector solution characteristics. The current research adopted the row vector geometric mean standard method, as shown in Equation (2); this is also called the normalization of the geometric mean of the rows (NGM) method, and is often used because it provides the best accuracy.

$$W_i=\frac{\sqrt[n]{\prod_{j=1}^{n} a_{ij}}}{\sum_{i=1}^{n}\sqrt[n]{\prod_{j=1}^{n} a_{ij}}} \quad \text{i，j = 1, 2, …, n} \qquad (2)$$

Next, we calculated the maximized eigen value $\lambda_{\max}$. First, we multiplied pair-wise the comparison matrix A by the eigen vector W_i to get a new vector W_i', as shown in Equation (3), where each vector value of W_i' was divided by each vector value that corresponds to the original vector W_i. Then, we used all of the obtained values to calculate an arithmetic average, deriving $\lambda_{\max}$ as shown in Equation (4):

$$W_i' = A \times W_i = \begin{bmatrix} 1 & a_{12} & \Lambda & a_{1n} \\ 1/a_{12} & 1 & \Lambda & a_{2n} \\ \mathrm{M} & \mathrm{M} & \mathrm{O} & \mathrm{M} \\ 1/a_{1n} & 1/a_{2n} & \Lambda & 1 \end{bmatrix} \times \begin{bmatrix} W_1 \\ W_2 \\ \mathrm{M} \\ W_n \end{bmatrix} = \begin{bmatrix} W'_1 \\ W'_2 \\ \mathrm{M} \\ W'_n \end{bmatrix} \qquad (3)$$

$$\lambda_{\max} = \frac{1}{n}\left(\sum_{i=1}^{n} \frac{W'_i}{W_i}\right) \qquad (4)$$

(7) Perform consistency test

(A) Consistency index

$$C.I. = \frac{\lambda_{\max} - n}{n-1} \qquad (5)$$

The smaller the consistency index C.I. value, the higher the consistency; moreover, C.I. = 0 means total consistency. Generally speaking, C.I. ≦ 0.1 denotes the acceptable evaluating values within the matrix. If C.I. ＞ 0.1, we recalculated the pair-wise comparison matrix until the C.I. value improved to an acceptable level.

(B) Consistency ratio

$$C.R. = \frac{C.I.}{R.I.} \qquad (6)$$

When the consistency ratio (C.R.) ≦ 0.1, the results of the data judgment are said to exhibit consistency. If C.R. ＞ 0.1, we recalculated the matrix until the C.R. value improved to an acceptable level. The random index (R.I.) is as shown in Table 3:

Table 3. Random Index

n	1	2	3	4	5	6	7
R.I.	0	0	0.58	0.9	1.12	1.24	1.32

Source: Saaty (1980)

(8) Find the overall consistency ratio hierarchy (CRH)

First, we calculated the overall consistency ratio hierarchy (CIH) and overall random index hierarchy (RIH) using the algorithms shown in Equations (7) ~ (9):

$$CIH = \sum_{j=1}^{h} \sum_{i=1}^{n_j} W_{ij} U_{i,j+1} \quad (7)$$

$$RIH = \sum_{j=1}^{h} \sum_{i=1}^{n_j} W_{ij} R_{i,j+1} \quad (8)$$

$$CRH = \frac{CIH}{RIH} \quad (9)$$

where n_j denotes the number of elements contained in the j^{th} level; W_{ij} is the comprehensive weight value of the i^{th} element in the j^{th} level; $U_{i,j+1}$ refers to the consistency index of the $j+1$ level toward the i^{th} element in the j^{th} level; and $R_{i,j+1}$ is the random index of the $j+1$ level toward the i^{th} element in the j^{th} level. If CRH $\leqq$ 0.1, then the overall hierarchy of the developed comparison evaluation is said to exhibit consistency.

(9) Calculate the total priority vector of the overall hierarchy

Once the consistency of the overall hierarchy reached an acceptable level, the last step consisted of combining the relative weight of the elements for each level to obtain each decision scheme that corresponds to the relative priority order of the decision goal.

4. Results and Discussion

4.1 Managers of Intellectual Property Rights Main Criterion

Table 3 shows each pair-wise comparison matrix and the weights for the IPR manager main criteria.

The results in Table 4 show that the C.I. and C.R. values are all smaller than

0.1; therefore, this pair-wise comparison matrix exhibits consistency in that every interviewee shows consistency toward the evaluation of this dimension. The importance sequencing is as follows: professional competency > basic competency > personality. As such, the results demonstrate that IPR managers emphasize professional competency.

Table 4. Pair-wise Comparison Matrix of the Main Criterion

Main criterion	Professional competency	Basic competency	Personality	Weight of each dimension
Professional competency	1.000	2.123	2.043	(1) 0.510
Basic competency	0.471	1.000	1.259	(2) 0.262
Personality	0.489	0.794	1.000	(3) 0.228

λ_{max} = 3.008，C.I. = 0.004，C.R. = 0.007

4.2 Professional Competency

The results in Table 5 show that the C.I. and C.R. values are both smaller than 0.1, meaning that this comparison matrix exhibits consistency; that is, every interviewee shows consistency in terms of professional competency comparisons. The importance sequence is as follows: evaluating IPR > locating the core patent group > calculating the chance of patents being granted > deciding on the best time to patent > applying for patents inlands and overseas > patent inventory.

Table 5. A Pair-wise Comparison Matrix of Professional Competency

Professional competency	(1)	(2)	(3)	(4)	(5)	(6)	Weight of each item	Relative weight
(1) Patent inventory	1.000	0.535	0.537	0.464	0.526	0.486	0.092	(11) 0.0467
(2) Locating the core patent group	1.870	1.000	1.391	0.925	1.057	1.005	0.188	(2) 0.0959
(3) Applying for patents inland and overseas	1.861	0.719	1.000	0.709	0.55	0.714	0.144	(5) 0.0733
(4) Evaluating IPR	2.154	1.082	1.411	1.000	1.362	1.330	0.217	(1) 0.1104
(5) Deciding the best time to patent	1.902	0.946	1.325	0.734	1.000	1.071	0.179	(4) 0.0911
(6) Calculating the chance of patents being granted	2.058	0.995	1.401	0.752	0.933	1.000	0.181	(3) 0.0922

λ_{max} = 6.018, C.I. = 0.004, C.R. = 0.003

4.3 Basic Competency

The results in Table 6 show that the C.I. and C.R. values are both smaller than 0.1, meaning that this comparison matrix exhibits consistency; that is, every interviewee shows consistency in terms of basic competency comparisons. The importance sequencing is as follows: problem-solving > communication & coordination > data collection > English proficiency > observation.

Table 6. Pair-wise Comparison Matrix of Basic Competency

Basic competency	(1)	(2)	(3)	(4)	(5)	Weight of each item	Relative weight
(1) Observation	1.000	0.919	0.826	0.571	0.869	0.162	(15) 0.0425
(2) Data collection	1.088	1.000	0.844	0.737	1.077	0.185	(10) 0.0485
(3) Communication & coordination	1.210	1.184	1.000	0.867	1.213	0.214	(8) 0.0561
(4) Problem-solving	1.752	1.358	1.153	1.000	1.639	0.266	(6) 0.0698
(5) English proficiency	1.151	0.928	0.824	0.610	1.000	0.174	(12) 0.0456

λ_{max} = 5.007，C.I. = 0.002，C.R. = 0.002

4.4 Personality

The results in Table 7 show that both the C.I. and C.R. values are smaller than 0.1, meaning that this pair-wise comparison matrix demonstrates consistency; that is, every interviewee shows consistency in terms of personality comparisons. The importance sequencing is as follows: sense of morality > sense of responsibility > ability to adapt > team spirit > professional confidence.

Table 7. Pair-wise Comparison Matrix of Personality

Personality	(1)	(2)	(3)	(4)	(5)	Weight of each item	Relative weight
(1) Professional confidence	1.000	0.512	0.399	0.614	0.624	0.116	(16)0.0264
(2) Sense of responsibility	1.955	1.000	0.965	1.215	1.021	0.228	(9) 0.0520
(3) Sense of morality	2.504	1.036	1.000	1.663	1.372	0.275	(7) 0.0626
(4) Ability to adapt	1.629	0.823	0.601	1.000	1.281	0.194	(13) 0.0442
(5) Team spirit	1.602	0.980	0.729	0.781	1.000	0.188	(14) 0.0429

λ_{max} = 5.027，C.I. = 0.007，C.R. = 0.006

Regarding the consistency of the entire level, the relevant indices are as follows:

CHI=0.0078
RIH=1.7611
CRH=0.0045

CRH is smaller than 0.1, showing that this pair-wise comparison matrix exhibits consistency; this implies that every interviewee shows consistency with regard to comparisons of this item.

For these types of research methods, AHP not only converts complicated problems into a simplified hierarchical system, but also takes expert opinions into account. Moreover, this discussion section is based on the results obtained using the fuzzy Delphi method.

This study uses the two steps that connect the fuzzy Delphi method to AHP, which previous studies did not employ. This difference makes our results more comprehensible. The five key factors revealed in the conclusion are the focus here. This differs from Chang et al. (2007), who only used the one step AHP; as such, the entire first distribution and key factors of the second distributions were hard to understand based on the order of the individual distributions and the results.

4.5 Comparison of advantages and disadvantages between other methods of analysis and the fuzzy Delphi method:

(1) Brainstorming:
(i) Advantage – more ideas can be considered
(ii) Disadvantage – opposing ideas cannot be judged

(2) Functional Analysis:
(i) Advantage – some limited time savings
(ii) Disadvantage– limited to certain functional ideas

(3) Observation:
(i) Advantages – simple; time-and-cost savings

(ii) Disadvantage – limited to narrow observations

(4) DACUM (developing a curriculum) method:
(i) Advantage – can assist with brainstorming
(ii) Disadvantage – requires additional time

(5) Interviews:
(i) Advantage – issues can be discussed in depth
(ii) Disadvantage – difficult to find interviewees

(6) Traditional Delphi:
Disadvantages – poor convergence, easily replaceable expert opinions, and high costs

Ishikawa et al. (1993) agreed that the fuzzy Delphi method has the advantages of decreased investigation times, more complete integration, proper use of expert opinions, the ability to generalize uncertain information from arbitrary presumptions, and time- and cost-savings. Therefore, research on the fuzzy Delphi method and AHP is indeed advantageous and legitimate.

5. Conclusions

This study investigates the first stage of the competency index development; the reviewing stage consists of a literature review, a sub-data analysis and direct communication with experts through interviews. Sample unit selection is limited to intellectual property services in use for more than three years, and service providers for intellectual property and patent management that are evaluated by the professional procedure listed in Section 3.3.1. In total, 22 standards are evaluated by the fuzzy Delphi method. The experience and opinions of 29 experts ensure

logical evaluations. Further, this research employs both the fuzzy Delphi method and AHP to explore various characteristics, as opposed to previous studies. The results include five factors from the Pair-wise Comparison Matrix as shown in Tables 4 through 7: (1) evaluating IPR, (2) locating the core patent group, (3) calculating the chance of patents being granted, (4) deciding the best time to patent and (5) applying for patents inland and overseas. These five major factors make up 47% of the total assessment of weights regarding the evaluation and screening of IPR management.

These five major factors provide a basic foundation. However, possible causes regarding the evaluation priority arrangements need to be confirmed through in-depth interviews. Management specialists must make judgments and recommendations on patent assignments, as well as master business deployment and research development, which are core competencies for excellent managers. Further, IPR management specialists are responsible for integrating, training and setting up management systems that provide patent management and other value-added services, which will ensure the greatest value for each patent. These core professional competencies are absolutely required by management specialists.

The results show that the sixth sub-index of professional competency is comprised of five key factors, which also are included as part of professional knowledge. Table 4 lists professional knowledge information from expert questionnaires, including C.I. and C.R. values that are lower than 0.1. This suggests high array consistency, a constant and rational expert decision-making process, and consistent opinions on various factors. Consequently, the research results fully express the relevant expert opinions.

Successful IPR managers can help companies obtain competitive advantages in the market. Therefore, one important strategic issue for organizations is how to select optimal managers for the IPR specialty: they should minimize the inputs required in order to achieve the maximum output. Nevertheless, during the decision making process, it is quite common for changes in the organizational environment and the complexity of the decision factors to become intermingled. Therefore, it is appropriate to form an evaluating project team within the organization to select the solution scheme. When choosing managers for the IPR specialty, it is common to

face problems related to multiple criteria and numerous decision makers. Because this type of problem can be characterized as one of unstructured openness, complex environmental factors need to be considered while making decisions. Some qualitative criteria are deeply influenced by accumulated experience and the subjective judgment of the decision makers, causing frequent changes in the criteria weights due to environmental variations associated with the decision-making time. To mitigate this, we invited managers from IPR related industries, management experts from governmental departments related to IPR industries, university professors or scholars with a background in IPR, and related industry executives to conduct comparisons; moreover, we employed AHP to understand the crucial factors involved in evaluating and screening IPR specialty managers within Taiwanese firms, resulting in actual effects and meanings. The findings of this research can act as a reference for Taiwan-based consultative bodies when they seek professionally competent IPR managers. As such, this study makes a solid contribution to the existing Taiwan-based research.

The research results show that professional competency was the main criterion for IPR managers, followed by basic competency. Accordingly, industry firms often combine complementary technologies and resources via professional competency to increase the competitive advantage of their companies (Hitt & Dacin, 2000; Schilling, 2005). This verifies and supports the viewpoints of several scholars, including Shiea (2006). In addition, with regard to the second level criterion, the five most frequently stressed key competency factors are: evaluating IPR; locating the core patent group; calculating the chance of patents being granted; deciding the best time at which to patent; and applying for patents both inland and overseas. The least frequently emphasized factors are: professional confidence; observation; team spirit; the ability to adapt; and English proficiency.

IPR management is crucial to any company's business operations and asset security. Therefore, the key responsibility of IPR management specialists is to protect these intangible properties. To do so properly, every step of the innovation process should be duly recorded, with any significant patents or trademarks registered. Establishing a system for monitoring IPR is especially important to ensure the consistent protection of IPR within the company, as well as to prevent

information leakage. Employees must abide by all related rules in order to prevent IPR infringement in terms of their own firms or those of competitors. Moreover, as a defensive measure, managing specialists should have a clear sense of the industries in which their company is involved. Recently, the government in Taiwan has launched an on-campus policy campaign pertaining to the issue of IPR protection in order to help students avoid infringements pertaining to the current information intensive age.

Finally, this study focuses on the real demands of industry in Taiwan; based on these, the competency index and weights of the IPR managers are established. These indexes and weights can serve as guidelines for the development of training courses, as well as for firm human resource management teams in terms of interviews, promotions, performance assessments, wage adjustments and leadership cultivation. Industry, government and academia in Taiwan have demonstrated significant progress in the field of IPR, particularly with regard to the quality of managers with a speciality in IPR. This study shares the vision of promoting the quality of such managing specialists. The US, apart from being an attractive market, possesses better knowledge and more mature systems with regard to IPR management; as such, Taiwanese companies should seek to emulate the knowledge and systems. Moreover, this study suggests that professional and practical know-how regarding IPR, as well as understanding IPR regularity, are important elements in terms of the training of IPR managers. In comparison, IP trading, IP evaluation and IPR infringement analysis—the more specific IPR sub-industries—require varied professional competencies and personalities. Therefore, they represent worthy subjects for future research.

6. Research Contribution

The selection of IPR management specialists focuses on their expertise, general competency, and personal traits. When standardizing evaluations,

comparisons of a two-element matrix reveal C.I. values of 0.004 and C.R. values of 0.007. As these values are less than 0.1, they correspond to expert judgments in terms of correlation and consistency (Saaty, 1980). In line with the results of Chang et al. (2007) and Shiea (2006), this study shows that expertise is most valued and emphasized by industries.

With the upsurge in the number of IP management specialists required to secure and protect IPR, the results demonstrate the increasing relevance of IPR. In general, Taiwanese industrial companies lack an understanding of the importance of IP management systems; as such, this type of expertise is highly valued locally. The current study uses the fuzzy Delphi method and AHP to investigate key evaluating and screening factors for IPR management specialists. The contributions of this study are as follows:

1. The Analytic Hierarchy Process (AHP) has often been referred to as an evaluation technique in previous decision analysis studies. However, this technique is far from perfect—it suffers from a number of flaws that must be overcome. Further, the process of decision-making often takes place under uncertain conditions. This study adopts a two-step “fuzzy Delphi method”, followed by the application of a quantitative AHP discussion, which is also included as an internal part of decision-making. The aims are to help decision makers improve their knowledge of how to select IPR managers, and to simplify the entire evaluation process.
2. This study includes a comprehensive literature review to summarize and organize the competence criteria for the selection of IPR managers. The use of AHP systemizes the vetting standards, improves the criteria range and also facilitates this easier evaluation process.
3. The targets of this study include: a) managerial or technical staff from IPR-related industries in Taiwan; b) technology or management experts from governmental departments related to IPR industries; c) university professors or scholars from academia and research institutes with a background in IPR-related industries, and an interviewee sample with high validity and consistency regarding the comparison of this item.
4. AHP and fuzzy theory can make the decisions more comprehensive and help

decision makers to undertake a more powerful alternative analysis. Through hierarchy analysis, we can achieve criteria systematization and convergence.

5. The employed fuzzy Delphi method saves survey and process time and costs. It can simplify the calculation process and reduce the study analysis costs, making the study output more reasonable and persuasive.

7. Managerial Implications

In this study, the five key factors in the selection of IPR specialists are: (1) evaluating IPR (0.1104); (2) locating core patents (0.0959); (3) calculating the rate of patent issuance (0.0922); (4) deciding on the best time to patent (0.0911); and (5) applying for domestic and foreign patents (0.0733). The core content refers to educating and providing better knowledge-related training and development for IPR management specialists. For Taiwan, the US represents not only a large IP market, but also an IP powerhouse with strong basics, where practical knowledge is mature and advanced. Further, by strengthening management communication abilities and professional competency skills, IP training can also stress issues such as US IP legal practices, as well as patent management abilities and rights. Other core responsibilities of IP management specialists include the protection of owner's IPR; the evaluation, development and research of IP developments; and technical suggestions in legal cases. Since specialists provide their IP-related services to clients, these specialists must possess strong personal communication skills such that they can secure cooperative business relationships with all levels and types of industry.

The current study features qualitative research methods with a special emphasis on theory construction through data analysis and expert interviews. To address the subject of "IPR specialities", we gather industry information directly and adopt the technique of competence analysis. In-depth interviews with individual experts help to widen our research scope and approaches to the data

analysis. The aim is to provide industry fitting competence indices.

Moreover, all five key factors elicited are related to professional competency (Table 5), which refers to background knowledge and technical skills. It is worth noting that the personal skill of English ability is not one of the key factors.

The research model was established to better evaluate and screen managers with IPR specialities. It may be employed to assist in: the design of staff training tools, the development of information systems for related courses, and the selection of suitable teaching trainers. In terms of talent discovery and employment, the model serves as a competency-differentiating tool. The aforementioned all represent interesting highlights of our results.

8. Research Limitations & Future Research Suggestions

Recent trends point to a marked increase in the demand for IPR managers and the promotion of professional standards pertaining to invention application, protection, and training, all of which will boost development in the Taiwan knowledge economy (Hwang, 2005). Foreign IPR professionals are not categorized according to industry; rather, they are usually placed in the consulting industry. As such, there is limited research in this field. The expertise of IPR managers focuses on the three areas of knowledge pertaining to management, law and technology. However, as IP management specialists are spread over a wide range of industries, the job-related demands and requirement are very different (Wang, 2003). Therefore, the major limitation of the current study is that it predominantly focuses on a survey completed by 29 experts from industrial, government, and education sectors. Intellectual property comprises patents, logos, copyrights, business confidential, IC, designs and other types of ownership. This study mainly investigates the types of knowledge that professional IPR managers should specialize in; therefore, we focus on patent management in this paper. Future

studies may consider investigating the EAM (extent analysis methods), or enlarging the IP research scope.

References

Catano, V. M., 1998, **Appendix 1: Competencies: A review of the literature and bibliography**, 1st, Ottawa, CA: Canadian Council of Human Resources.

Chang, Shu-Hsuan, Yang, Yi-Lin, and Shen, Yung-Chi, 2007, "Competency index construction for employees of the intellectual property technology service industry," **Journal of Human Resource Management**, Vol. 7, No. 2, 27-48.

Chen, Song-Bo, Hong, Chian-Tsai, and Hsiao, Chi-Fei, 2009, **Planning, Research & Development**, 1st, Taipei, TW: National Open University.

Coomer, C., 1998, "Teaching the new basic skills," **Business Education Forum**, Vol. 53, No. 2, 42-43.

Daw, Kun-Shing, 1993, **A game of decision making method-AHP introductory**, 1st, Taipei, TW: Jian-Hung.

Hitt, M. A. and Dacin, M. T., 2000, "Partner selection in emerging and developed market contexts: Resource- based and organizational learning perspectives," **Academy of Management Journal**, Vol. 43, No. 3, 446-449.

Hsu, T. H. and Yang, T. H., 2000, "Application of fuzzy analytic hierarch process in the selection of advertising media," **Journal of Management and Systems**, Vol. 7, No. 1, 19-39.

Hsu, Tsun-Ho, 1998, "The Fuzzy Delphi Analytic Hierarchy Process," **Journal of Chinese Fuzzy Systems Association**, Vol. 4, No. 1, 59-72.

Hwang, Mei-Rui, 2005, **The Configuration of Evaluation Models for IR Rights Service Technicians**, unpublished Master's thesis, National Changhua University of Education.

Industrial Development Bureau, 2009a, "Ministry of Economic Affairs, services related to the IP rights management of technology trading-Taiwan technology market," http://www.twtm.com.tw/resource/doc/ip.doc, accessed on May 20, 2009.

Industrial Development Bureau, 2009b, "Ministry of Economic Affairs, services related to the IP rights management of technology trading-Taiwan technology market," http://www.twtm.com.tw/resource/explain.htm, accessed on June 10, 2009.

Ishikawa, A., Amagasa, T., Tamizawa, G., Totsuta, R., and Mieno, H., 1993, "The Max-Min Delphi Method and Fuzzy Delphi Method via Fuzzy Integration," **Fuzzy Sets and**

System, Vol. 55, No. 3, 241-253.

Ministry of Economic Affairs, 2009a, "Taiwan technology market," http://www.twtm.com.tw/resource/doc/ip.doc, accessed on October 8, 2009.

Ministry of Economic Affairs, 2009b, "Registration of Qualification Standards and Individual Definition Content for IPR Technical Services Organizations," http://www.twtm.com.tw/resource/doc/ip.doc, accessed on October 8, 2009.

Ministry of Economic Affairs, 2009c, "Taiwan technology market," http://www.twtm.com.tw/resource/explain.htm, accessed on October 8, 2009.

Murray, T. J., Pipino, L. L., and Gigch, J. P., 1985, "A Pilot Study of Fuzzy Set Modification of Delphi," **Human Systems Management**, Vol. 5, No. 1, 76-80.

Queeney, D. S., 1996, "Continuing professional education" in Craig, R. L. (ed.), **The ASTD training and development handbook**, Fourth Edition, New York: McGraw-Hill, 698-724.

Saaty, T. L. and Vargas, L. G., 1982, **The Logic of Priorities**, 1st, Boston: Kluwer-Nijhoff.

Saaty, T. L., 1980, **The Analytic Hierarchy Process**, 2nd, New York: McGraw-Hill.

Schermerhorn, J. R., Hunt, J. G., and Osborn, R. N., 1988, **Managing organizational behavior**, 4th, New York: John Wiley & Sons.

Schilling, M. A., 2005, **Strategic Management Technological Innovation**, 3rd, New York: McGraw-Hill.

Shiea, Ea-Cheng, 2006, "The new development of the main manpower ability for the future," http://hrd.college.itri.org.tw/article.aspx.id=173, accessed on August 20, 2006.

Spencer, Jr. and Spencer, S., 1993, **Competence at work: Model for superior performance**, 1st, New York: John Wiley & Sons.

Tsang, E. W. K., 1998, "Motives for Strategic Alliance: A Resource-Based Perspective," **Scandinavian Journal of Management**, Vol. 14, No. 3, 207-221.

Virtanen, T., 2000, "Changing competences of public managers: Tensions in commitment," **The International Journal of Public Sector Management**, Vol. 13, No. 4, 334-336.

Wang, Gong, 2003, "Suggestions for Development Measures and Policies of Strategic Service Industry. ", **2003 Industry Strategy Conference Research Repository**, Taipei, Taiwan.

Waugh, S., 1990, "Workplace literacy and basic skills." Working paper, ERIC Documents Reproduction Service.

Webster, J. and Watson, R. T., 2002, "Analyzing the past to prepare for the future: Writing a literature review," **MIS Quarterly**, Vol. 26, No. 2, 13-23.

Wood, R. and Payne, T., 1998, **Competency-based recruitment and selection**, 1st, New York: John Wiley & Sons.

Xu, Qiong-Wen, 2003, "An Academic Paper Presentation of National Science Policies and

International Competitiveness.” Working paper, National Tsing-Hua University.

Zhao, Zhi-Yang and Huang, Qi-Lun, 2004, “A Study of Professional Competence of Knowledge Management in Taiwan High-Tech Industry,” **Human Resource Management**, Vol. 4, No. 2, 1-24.

Appendix: Questionnaire

IPR Specialty Competency Managers

Factors	Importance of one factor over another									Factors
	9:1	8:2	7:3	6:4	5:5	4:6	3:7	2:8	1:9	
Professional Competency										Basic Competency
Professional Competency										Personality
Basic Competency										Personality

1. Professional Competency

Factors	Importance of one factor over another									Factors
	9:1	8:2	7:3	6:4	5:5	4:6	3:7	2:8	1:9	
Patent Inventory										Locating the core patent group
										Applying for patents inland or overseas
										Evaluating IPR
										Deciding the best time to (apply for) patents
										Calculating the chance of patents being granted
Locating the core patent group										Applying for patents inlands and overseas
										Evaluating IPR
										Deciding the best time to patent

Factors	Importance of one factor over another									Factors
	9:1	8:2	7:3	6:4	5:5	4:6	3:7	2:8	1:9	
										Calculating the chance of patents being granted
Applying for patents inlands and overseas										Evaluating IPR
										Deciding the best time to patent
										Calculating the chance of patents being granted
Evaluating IPR										Deciding the best time to patent
										Calculating the chance of patents being granted
Deciding the best time at which to patent										Calculating the chance of patents being granted

2.Basic competency

Factors	Importance of one factor over another									Factors
	9:1	8:2	7:3	6:4	5:5	4:6	3:7	2:8	1:9	
Observation										Data Collection
										Communication & Coordination
										Problem-Solving
										English Proficiency

Factors	Importance of one factor over another									Factors
	9:1	8:2	7:3	6:4	5:5	4:6	3:7	2:8	1:9	
Data Collection										Communication & Coordination
										Problem-Solving
										English Proficiency
Communication & Coordination										Problem-Solving
										English Proficiency
Problem-Solving										English Proficiency

3.Personality

Factors	Importance of one factor over another									Factors
	9:1	8:2	7:3	6:4	5:5	4:6	3:7	2:8	1:9	
Professional Confidence										Sense of Responsibility
										Sense of Morality
										Ability to Adapt
										Team Spirit
Sense of Responsibility										Sense of Morality
										Ability to Adapt
										Team Spirit
Sense of Morality										Ability to Adapt
										Team Spirit
Ability to Adapt										Team Spirit

4.Questionnaire sample scale respondents

Sample original	Total
Business in industry representatives, managerial expert from IPR-related industries	10
Business in governmental departments related representative technology or management experts	10
University professors or scholars with a background in IPR-related industries from academia and research institutes representatives.	9

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