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Appraising Intangible Assets from the Viewpoint of Value Drivers

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ABSTRACT. This article does not intend to actually valuate intangible assets but focuses to investigate the relative value distribution of corporate intangible assets, and this links closely to the concept and application of value drivers. This is because we believe that drivers or attributes of the value significantly determine how the virtual value of these intangibles can be created for companies. We apply the analytic hierarchy process (AHP) to the appraising process of intangible assets. The AHP method can mainly sort the non-financial value drivers in order according to their weighted contributions. Therefore, the key purpose of this article is to develop a tentative model for the evaluation of intangible assets, which helps business to correctly appraise corporate value ratios and avoid bias due to mainly relying on financial statements when measuring an entity's value. In addition, in view of the significant proportion of intangible assets over total assets in high-technology industries, this research, then, uses six industries in Hsinchu Science Park, Taiwan, as its research objects in order to test the applicability of its model, as well as exploring the value weights of intangible assets and its evaluation among different technology industries. Besides, the empirical result of this article is mainly to support business appraisal and thus improves the effectiveness of value-based management.

KEY WORDS: intangible assets, value drivers, AHP method, evaluation model, hi-tech industry, business appraisal

Introduction

Intellectual capital or intangible assets are recognized as the most important assets of many of the world's largest and most powerful companies; it is the foundation for the market dominance and continuing profitability of leading corporations. In addition, it is often the key objective in mergers and acquisitions, and knowledgeable companies are increasingly using licensing routes in order to transfer these assets to low tax jurisdictions. Nevertheless, the role of intangible assets in business is insufficiently understood. Accounting standards are generally not helpful in representing the worth of intangible assets in company accounts, and they are often under-valued, under-managed, or under-exploited. Namely, despite the importance and complexity of intangible assets, there is generally little coordination between the different professionals dealing with these relating issues. Recently issued accounting standards have created the need for valuation of intangible assets for financial statement purposes. Arriving at these valuations can be a complicated process. This raises the question of which values remain hidden within internally developed intangibles. Therefore, the balance sheet undoubtedly has significant limitations in terms of reporting an entity's true value. Internally developed intangible assets, even those for which a fair value may be determinable, are not recognized in the financial statements. Investors and creditors recognize these limitations and presumably perform independent research and analysis in their investment and credit decisions.

Meanwhile, one of the most vexing problems in business valuation is the issue of valuing intangible assets. They come in many forms, including patents and trademarks, copyrights, mailing lists, exclusive contracts, royalty agreements, work-in-progress, proprietary designs, and many others. These assets and intellectual properties have a real value that can be estimated through investigation and objective calculation. Sveiby (2002) reviewed 28 intangible asset valuation methods, based on the frameworks of Luthy (1998) and William (2001), and classified them into four categories. However, there is still no

universal valuation method. Studies regarding intangible assets evaluation involve the valuation determinants (Chiu and Chen, 2004), the evaluation methods (Dubin, 2007; Johnson, 1999; Kaplan and Norton, 2004), and the relationship between intangible assets and share price (Chan et al., 2001; Johnson et al., 2002).

This article, however, does not intend to actually valuate intangible assets but focuses to investigate the relative value distribution of corporate intangible assets, and this closely links to the concept and application of value drivers. This is because we believe that drivers or attributes of the value significantly determine how virtual value of these intangibles can be created for companies. We apply the analytic hierarchy process (AHP) to the appraising process of intangible assets. The AHP method can mainly sort the non-financial value drivers according to their weighted contributions. Therefore, one of the key purposes of this article is to develop a tentative model for the evaluation of intangible assets, which helps businesses to correctly appraise corporate value ratios and avoid bias due to mainly relying on financial statements when measuring an entity's value. In addition, in view of the significant proportion of intangible assets over total assets in high-technology industries, this research, then, uses six industries in Hsinchu Science Park, Taiwan, and one virtual case as its research objects to test the applicability of its model, as well as exploring the value weights of intangible assets and its evaluation among different high-technology industries.

Intangible asset

Value creation

Corporations sometimes choose not to focus on value creation and, instead, unintentionally make decisions that systematically decrease the long-term value of their businesses. This is perhaps because managers tend to define their organizations' interests narrowly. This constricted view is powerfully reinforced by financial accounting systems that are well adapted to the industrial economy but are inadequate in the information economy. The accounting and finance conventions of the industrial age are effective at valuing tangible assets, but they largely ignore the value of harder-to-quantify assets, such as employee satisfaction, learning, R&D effectiveness, and customer loyalty (Mathis and Jackson, 2003). In the information age, intangible assets are far more important than the tangible assets that traditional accounting systems were designed to measure. If management defines the organization's self interest (and consequently its goals) too narrowly – for example, to maximize this year's or this quarter's reported earnings, it will view this interest as being at odds with the needs of customers and employees. Given that perspective, in the short term, every dollar spent on employee training, for instance, is a dollar of lost profit. Every additional dollar earned from a customer, even if it comes at the cost of poor service or price gouging, improves this quarter's results (Kotler, 2003). Alternatively, if managers define their company's interests broadly enough to include the interests of customers and employees, an equally powerful spiral of value creation can occur. Highly motivated, well-trained, properly rewarded employees deliver outstanding service, while effective R&D investments lead to products that enjoy a significant value-adding advantage and generate higher margins. Satisfied, loyal customers (and new customers responding to word-of-mouth referrals) drive revenue growth and profitability for investors (Kotler, 2003).

One way to build an understanding of these dynamics is to identify the key capabilities, resources, and relationships that are the basic ingredients of value creation for a particular firm and to think of these ingredients as assets that either grow or diminish over time, depending on the way in which they are managed. This is, then, useful to map a company's key assets by building a "value-creation net" focused on employees, processes, customers, and investors (see Figure 1). A firm's capabilities and skills determine the degree to which the company can meet these requirements and provide a greater value than its competitors (Hamel, 1991). In building the value-creation net, managers should decide which assets are the most important drivers of the company's value-creation system. For example, employee learning and job satisfaction are two assets that could be tracked on the part of employees in the value-creation net. As managers identify the strategic assets that belong in each value-creation net, they also must articulate the relationships among these

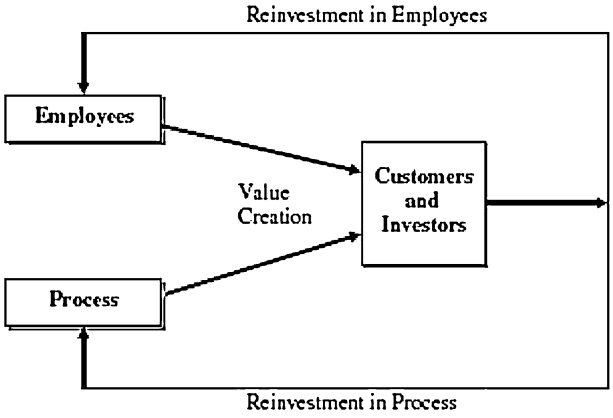

Figure 1. Value-creation net. *Source*: Lin and Lin (2006, p. 97).

assets. By tracing the dynamics through which customer, employee, and process assets accumulate, interact, and ultimately drive profitable growth, a company will be well on its way to managing the fundamentals of value creation and avoiding the pitfalls of management by following a set of narrow financial measures.

Value driver

Theoretically, an asset, whether tangible or intangible, is assessed through its expected future discounted cash flow. This is the basic principle of the discounted cash flow. From such premise, strategies drawn by a company may positively or negatively affect a given company's value. Consistent with this principle, Lev (2001) defines intangible assets as a right for future benefits that do not have a physical or financial body (stocks or debt securities). In order to allow a better understanding of the intangible asset concept, it is necessary to present its classification. The first classifying proposals of intangible assets appeared several decades ago. More recent classifying proposals of intangible assets may be attributed to authors, such as Sveiby (1997), Stewart (1999), Lev (2001), Reilly and Schweihs (1999), among others. Table I depicts a classification proposed by Kayo (2002).

Table I presents a taxonomy for the intangibles assets. Some authors consider such assets to be non-financial value-drivers. However, it is necessary to differentiate intangible assets from drivers that lead to the formation of their values. This means intangible assets must not be considered as drivers themselves. Drivers must be attributes that would be responsible by the definition of the intangible assets' values. An example of a possible list of non-financial drivers of value is presented by Kalafut and Low (2001). These authors suggest a list containing nine drivers, which are the most critical ones in their researches. These drivers are innovation, quality, customer relation, management capabilities, alliances, technology, brand value, employee relations, and environmental and community issues.

Such drivers are part of what Kalafut and Low call the value-creation index. Non-financial drivers, as suggested by Kalafut and Low, are attributes that may be associated with different types of intangible assets. The higher or lower intensity in the relative importance of each driver may influence the formation of value for intangible assets. Non-financial drivers are of major importance in allowing the understanding of the nature of intangible assets. According to Feltham and Ohlson (1995), the value

TABLE I

A proposal for classifying intangible assets

Type of intangible	Main intangible assets
Human assets	Knowledge, talent, capabilities, skills, employee's experience, superior management, key employees, training and development, among others
Innovation assets	Research and development, patents, secret formulas, technological know-how, among others
Structural assets	Procedures, software, databases, information systems, market intelligence, market channels, among others
Relationship assets	Brand, trademarks, copyrights, contracts with clients, suppliers, contract of licensing, franchise, among others

Source: Kayo (2002, p. 19).

of intangibles can cause abnormal profits. Evidently, in order to allow such profit to occur, sales and services revenue must be maximized and several types of expenditures (costs and expenses) must be minimized in order for the sales to be maximized. It is necessary to understand why consumers buy a given product from a company and do not buy it from its competitor. What leads, for instance, a consumer to buy a luxury automobile, such as the Mercedes, and not to buy a popular car, such as a VW? It can be supposed that the consumer is interested in attributes, such as status, tradition, high-technology, stability, and comfort. These attributes form the so-called purchasing drivers. The two-first drivers (status and tradition) have an essentially intangible nature. High technologies may have a tangible influence, such as the use of on-board computers. At last, stability and comfort are essentially tangible because they depend on physical attributes. Each type of asset, whether tangible or intangible, exerts differentiated influences on each driver. For instance, the brand may exert a major influence on the status and tradition drivers. As status and tradition are intangible drivers by their nature, it can be deducted that the brand is an intangible asset.

However, again, it is important to remember that the analysis of drivers is only part of the evaluation process of intangible assets. Once the process is complete, these drivers must be associated to economical–financial forecast results. For example, it can be used as a variation of the discounted cash-flow method combined with the economic value added (EVA) concept.

Methodology

This research primarily uses the AHP in order to explore the issues in question. For managerial purposes, it is important that the management succeeds not only in estimating the value of the intangibles, but also in identifying the relative contributions of the different drivers to the total of the company's intangibles. This way, the managerial strategies may be better planned in order to allow investments and efforts to be allocated as to contemplate the importance of the value drivers. In such context, the AHP proposed by Saaty (1996) appears to be an extremely useful mechanism that allows the change of the qualitative and subjective comparisons between drivers in quantitative and cardinal features.

The AHP method is a multi-criteria method that is analysis based on an additive weighting process, in which several relevant attributes are represented through their relative importance. AHP has been extensively applied by academics and professionals, mainly in engineering applications involving financial decisions associated with non-financial attributes (Saaty, 1996). In the specific case of the intangible asset's analysis, the AHP allows the ''hierarchization'' of subjective opinions in categories of drivers of value, making possible a quantitative treatment that leads to a numerical estimate of the relative importance of each driver.

Through AHP, the importance of several attributes is obtained from a process of paired comparison, in which the relevance of the attributes or categories of drivers of intangible assets is matched two-on-two in a hierarchic structure. Initially, the management must compare the several drivers following the verbal-judgment scale presented in Table II. Intermediate values are possible, and they correspond to the intermediate importance relationships among attributes.

For instance, in comparing the relative importance between drivers A_i related to A_j, if the judgment is 9.00, the management considers that the attribute A_i is extremely more important than attribute A_j in generating intangible assets. With this procedure, the verbal judgment mechanism composed by the management's perceptions is transformed in numerical equivalents. Thus, the managers must perform the qualitative comparison of every driver among themselves, according to the previous table and, thus, obtaining Table III.

TABLE II

Verbal scale for pairs of compared attributes

Verbal judgment	Numerical rating
Extremely preferred	9
Very strongly preferred	7
Strongly preferred	5
Moderately preferred	3
Equally preferred	1

Source: Saaty (1980).

TABLE III

Matrix of paired comparison among *n*-evaluation criteria

Attribute	A_1	A_2	…	A_n
A_1	$X_{11} = 1$	X_{12}		X_{1n}
A_2	$X_{21} = 1/X_{12}$	X_{22}		X_{2n}
…				
A_n	$X_{n1} = 1/X_{1n}$	$X_{12} = 1/X_{2n}$		$X_{nn} = 1$

Source: Saaty (1980).

In the AHP model, if the relative importance of A_i related to A_j is X_{ij}, the opposite comparison of attribute A_j related to attribute A_i is equal to $1/X_{ij}$. Obviously, the diagonal of the matrix of the comparison is equal to 1.00, since each driver is compared to itself. Considering the paired comparison's matrix and based on mathematical concepts of eigenvalues and eigenvectors, Saaty (1996) sets that the relative weights of each attribute may be calculated through the following equation:

$$W_i^{(j)} = \frac{X_{ij}}{\sum_{i=1}^{n} X_{ij}}, \quad \text{with } w_i = \frac{\sum_{j=1}^{n} w_i^{(j)}}{n} \tag{1}$$

The relative weights may be submitted to a cardinal comparison. This way, the evaluation based on multiple criteria is performed weighting the indicators of attributes of each alternative by the relative weights. AHP allows the identification of a parameter on the consistence level of the relative importance of the attributes, since subjective judgment may present decision biases. Such index reflects the coherence level of comparisons among attributes, and this is calculated through the following equation:

$$\mathrm{CI} = \frac{\lambda - n}{(n-1)\beta}, \ \mathrm{com}\lambda = \frac{\sum_{i=1}^{n} \alpha_i}{n}, \ \alpha_i = \frac{\sum_{j=1}^{n} x_{ij} * w_i}{w_i}, \tag{2}$$

where [ ] = 0,0; 0,0; 0,58; 0,90; 1,12; 1,24; 1,32; 1,41; 1,45; 1,49 for $n = 1, 2, \ldots, 10$ represents a consistent index (CI) of a random paired comparison matrix. Thus, AHP incorporates several attributes when evaluating alternatives and allows the monitoring of the managers' coherence related to the judgment of the relative importance of the attributes. The values of w_i correspond to the relative weights of each attribute A_i, and the index CI represents a coherence measurement of the comparative evaluation performed by the managers. The lower the CI value the more consistent the judgments. Generally, it is considered that the results of the paired comparisons are coherent whenever the consistency indexes are lower than 0.10.

Constructing the research model

Taking into consideration categories defined by Kalafut and Low (2001) and other authors as noted before, the evaluation model of this research can be divided into five appraising dimensions and 22 appraising criteria for probing into the issue regarding the value weights of intangible assets in technology business. We also invite experts and other scholars in the relating fields to confirm the fit and the reasonableness of the model construct. The purpose of the questionnaire is to help allocating the relative importance of each appraising dimension and criterion while comparing pair by pair. First, we issued the questionnaires with five dimensions, including "Innovation and Technology," "Management Capability," "Employee Capability," "Customer Relationship and Alliance," and "Goodwill," to respondents in order to explore the perceived relative importance (weights). Second, again, we examined the appraising criteria underlying the five dimensions mentioned above in order to gain the respondents' perceived relative importance (weight). By doing so, the respondents' views of each relative importance of appraising criterion could be reflected and analyzed further. The evaluation model of intangible assets constructed by this research is depicted in Figure 2.

Empirical analysis

Issuing and recollecting of the questionnaires

The targets of this research questionnaire are the six industries in Hsinchu Science Park, Taiwan, including integrated circuits industry, communication

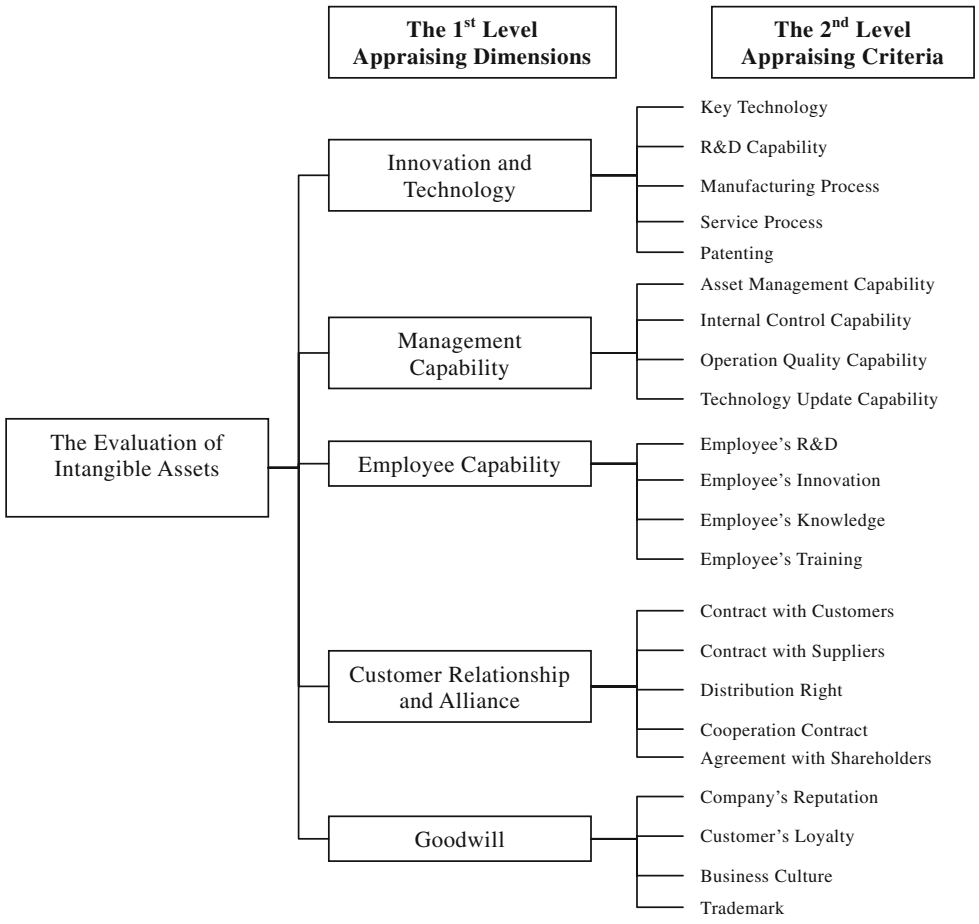

Figure 2. The evaluation of intangible assets in Taiwan's high-technology industries.

industry, computer and peripheral equipment industry, optoelectronic industry, precision machinery industry, and biotechnology industry. The experts interviewed are professional executives from each department of these industries, including operation, marketing, human resources, research and development, and finance, with work experience of more than 15 years. This article is aimed to understand experts' perceptions regarding the weights of value drivers in different industries. Therefore, the AHP method is used during the survey, attempting to quantitatively rank these non-financial contributions. The implicit assumption underlying here is that genuine intangible asset values may vary between firms, but professional executives within the same industry should have a converged idea regarding the ways in which the intangible assets should be arrayed when they consider comparing the relative importance of the value drivers. Therefore, directly after obtaining the ideal measure of intangible assets surveyed by AHP, other methods can be used by the management in order to assess the way in which the arrangement of the individual company's intangibles is diverged from the so-called ideal structure; this is particularly useful while encountering business mergers and acquisitions since it serves as a helpful reference for business valuation. A total of 328 copies of the questionnaire were issued, 142 copies recollected, and 118 copies with CI/CR ratio less than 0.1 were selected to be effective analyzing samples. See Table IV for statistics of recollecting status. Note that the ratio of effective questionnaires in integrated circuit industry is not the highest, even though more copies were issued in this industry due to its lager number of clients, capital, as well as operation sales than other industries, which could reach more respondents.

TABLE IV

Statistics of questionnaires recollected in each industry

Industry	Copies of questionnaire issued	Copies of questionnaire recollected	Copies of effective questionnaire	Percentages of effective copies (%)
Integrated circuit	220	90	83	37.73
Communication	23	10	7	30.43
Computer and peripherals	36	14	10	27.78
Optoelectronic	19	10	8	42.11
Precision machinery	14	9	5	35.71
Biotechnology	16	9	5	31.25
Total	328	142	118	35.98

Error rate for all analyzed computation is set to less than 0.01.

AHP weights

According to the investigation of weights (relative importance) of intangible asset appraising dimensions in this research, ''technology innovation'' has been considered the most important dimension of the five by professional executives in integrated circuit, communication, computer and peripherals, and optoelectronic industries. The weights are 0.422 for optoelectronic industry, 0.385 for computer and peripherals industry, 0.337 for communication industry, and 0.277 for integrated circuits industry. Because R&D and technology innovation are the major sources of competence in the above industries, the innovation and technology dimension is emphasized in order to correspond with the fast-changing market technological demand effectively. On the other hand, the precision machinery industry views the ''goodwill'' dimension to be most important and the weight of the dimension is 0.281. We believe that this is because the precision machinery industry trades mainly through the traditional business channel (B2B) that frequent trading and cooperation between enterprises and raises the importance of company goodwill in this industry. Then, ''management capability'' is thought to be the most crucial dimension in biotechnology industry with the weights at 0.346 due to its industry characteristics of high R&D investment risks. In other words, there are many other potential factors that may reduce the technology efforts, and thus, dimensions, such as asset management, laws and regulations, internal control, commercialization process, integration capability, and management capability, are much greater concerns in this industry than the technical concern.

The result of our research also reflects the fact that the relative importance of intangible asset attributes varies among technology industries, for example, integrated circuit, communication and optoelectronic industries. ''Key technology'' and ''R&D capability'' are emphasized when they evaluate their intangible assets, and among which, the optoelectronic industry also pays much attention to the ''internal control'' criterion in order to accord with the characteristics of quality, innovation, and fast development that high-technology industries pursue. In addition, integrated circuit, computer and peripherals, and precision machinery industries think highly of ''goodwill'' as well, and specifically, the precision machinery industry even places more emphasis on the ''customer loyalty'' criterion. Furthermore, ''asset management capability,'' ''operation quality capability,'' ''technology update capability,'' ''patent,'' and ''employee R&D'' criterion are highly valued in biotechnology industry to cohere with the industry's emphasis on criteria, such as management capability and development of patens. Finally, the top- or second-ranked intangible asset concern is indicated as ''key technology'' among five technology industries in our investigation, including integrated circuit, communication, computer and peripherals, optoelectronic, and precision machinery industries. See Tables V and VI for ideal value weights in the light of intangible assets appraising dimensions and criteria in each technology industry from our survey.

TABLE V

The weights of appraising dimensions of intangible assets in different technology industries

Industry category/dimension	Technology innovation	Management capability	Employee capability	Customer relationship	Goodwill
Integrated circuit	0.277 (1)	0.205 (2)	0.185 (3)	0.169 (4)	0.164 (5)
Communication	0.337 (1)	0.277 (2)	0.126 (5)	0.130 (3)	0.129 (4)
Computer and peripherals	0.385 (1)	0.171 (2)	0.168 (3)	0.119 (5)	0.158 (4)
Optoelectronic	0.422 (1)	0.178 (3)	0.182 (2)	0.142 (4)	0.076 (5)
Precision machinery	0.232 (2)	0.185 (3)	0.182 (4)	0.119 (5)	0.281 (1)
Biotechnology	0.191 (2)	0.346 (1)	0.150 (4)	0.186 (3)	0.126 (5)

Error rate for all analyzed computation is set to less than 0.01.

TABLE VI

The weights of appraising criteria of intangible assets in different technology industries

Appraising (dimension)/ criterion/industry	Integrated circuit	Communication	Computer and peripheral	Optoelectronic	Precision machinery	Biotechnology
Innovation and technology						
Key technology	0.095 (1)	0.111 (2)	0.151 (1)	0.131 (2)	0.110 (1)	0.041 (10)
R&D capability	0.063 (3)	0.116 (1)	0.062 (4)	0.134 (1)	0.053 (8)	0.033 (13)
Manufacturing process	0.041 (11)	0.060 (6)	0.052 (7)	0.067 (3)	0.023 (15)	0.032 (14)
Service process	0.035 (13)	0.022 (15)	0.049 (9)	0.042 (10)	0.018 (20)	0.028 (17)
Patenting	0.040 (9)	0.028 (14)	0.072 (3)	0.047 (8)	0.028 (13)	0.057 (4)
Management capability						
Asset management capability	0.043 (10)	0.072 (4)	0.059 (5)	0.036 (13)	0.033 (11)	0.166 (1)
Internal control capability	0.048 (7)	0.097 (3)	0.035 (12)	0.041 (11)	0.053 (8)	0.048 (6)
Operation quality capability	0.059 (4)	0.045 (7)	0.027 (14)	0.045 (9)	0.058 (7)	0.070 (2)
Technology update capability	0.055 (5)	0.063 (5)	0.049 (9)	0.056 (6)	0.040 (10)	0.063 (3)
Employee capability						
Employee R&D	0.066 (2)	0.037 (9)	0.056 (6)	0.061 (4)	0.069 (5)	0.056 (5)
Employee innovation	0.046 (8)	0.036 (10)	0.041 (11)	0.049 (7)	0.077 (4)	0.043 (8)
Employee knowledge	0.040 (11)	0.032 (11)	0.048 (10)	0.040 (12)	0.021 (18)	0.029 (16)
Employee training	0.033 (15)	0.020 (16)	0.023 (16)	0.032 (14)	0.015 (21)	0.022 (18)
Customer relationship						
Contract with customers	0.051 (6)	0.036 (10)	0.050 (8)	0.057 (5)	0.024 (14)	0.048 (6)
Contract with suppliers	0.028 (19)	0.030 (13)	0.016 (20)	0.030 (15)	0.019 (19)	0.022(18)
Distribution right	0.028 (19)	0.015 (18)	0.019 (18)	0.018 (17)	0.031 (12)	0.045 (7)
Cooperation contract	0.032 (16)	0.031 (12)	0.018 (19)	0.017 (18)	0.022 (17)	0.030 (15)
Agreement with shareholders	0.030 (17)	0.018 (17)	0.015 (21)	0.022 (16)	0.023 (16)	0.042 (9)
Goodwill						
Company's reputation	0.063 (3)	0.039 (8)	0.082 (2)	0.036 (13)	0.084 (3)	0.032 (14)
Customer's loyalty	0.039 (12)	0.018 (17)	0.029 (13)	0.018 (17)	0.090 (2)	0.041 (11)
Business culture	0.034 (14)	0.060 (6)	0.025 (15)	0.014 (19)	0.064 (6)	0.035 (12)
Trademark	0.029 (18)	0.012 (19)	0.022 (17)	0.008 (20)	0.044 (9)	0.019 (19)

Error rate for all analyzed computation is set to less than 0.01.

Reliability and validity

Our results in this section can be deemed trustworthy. Regarding the reliability, this research uses internal consistency reliability as the testing method. The CI and the CR of AHP are also applied to estimate the internal consistency reliability. The inequations, $CI \leqq 0.1$ and $CR \leqq 0.1$, are used to test the reliability of the questionnaire. In addition, the questionnaire meets the theoretical requirements with acceptable internal consistency reliability.

The validity is concerned with both nomological validity and content validity. Since this research integrates theories from other researchers (mainly Kalafut and Low, 2001), while developing the questionnaire on different levels, the contents of the questionnaire should be reasonable in terms of the nomological validity. Furthermore, under the review of several experts and scholars, the constructs and criterion are affirmed to have a clear expression and to effectively measure the objectives. Thus, the questionnaire should have a certain degree of content validity.

Conclusion and suggestions

This article has constructed a tentative model for the evaluation of intangible assets, which helps businesses avoid bias due to mainly relying on financial statements when measuring an entity's value. In view of the significant proportion of intangible assets over total assets in high-technology industries, this research then uses six industries in Hsinchu Science Park, Taiwan, as its research objects in order to test the applicability of its model, as well as exploring the value weights of intangible assets and its evaluation among different high-technology industries. According to the execution of the above research, we, thus, summarize the following research conclusion and managerial implications.

The hierarchization of value drivers

The financial literature presents several alternatives for the intangible assets valuation. One such alternative is based on the discounted cash flow method. Through such criterion, the intangibles valuation may be described by at least four steps, which are as follows: (1) the total cash flow forecast (financial and economical results), (2) the identification and separation of tangible assets, (3) the intangible assets ''hierarchization,'' and (4) the discount value of the intangible assets cash flow, with the appropriate cost of capital rate that reflects its risk level. The third step, intangible assets ordering, is complex and subjective. This procedure involves subjective analysis that may considerably influence the results of the valuation process. The concern of the subjectivism may be softened by applying the AHP method when determining the hierarchy of the value drivers. The purpose of this study is to show the application of the AHP method as a supporting instrument for the intangible assets valuation process. AHP allows quantitatively ''hierarchizing'' non-financial value drivers.

The ideal distribution structure of intangible assets

Evaluating and managing intangible assets involve the controlling and the planning of several components of difficulty, measurement, and large subjectivity. In order to help this process, one can apply multi-criteria decision models, such as AHP, considerably improving the magnitude of the analysis, mainly when the subjectivism may influence the evaluations. As to the evaluation of intangible assets, AHP allows that different types of assets, as well as their several components, can be ordered as to their relative importance. By adopting a simple quantitative procedure, the AHP technique allows a weighting procedure that represents the participation of a value driver on the total value generated by the intangibles. One can identify and quantitatively compare which are the main drivers of value of intangible assets. Therefore, the resulted weights in the structure of intangible asset evaluation constructed by this research represent the expected intangible asset distribution structure in each industry. Based on our resulted intangibles structure, we hope that in the end the same industry management may accomplish research among the decision makers as to qualitatively evaluate several value drivers inside a company's context in order to establish a reference for resource distribution regarding business managerial

decision making and, furthermore, to properly manage and accumulate its intangible assets.

The improvement of value-based management

Value-based management (VBM) is the management approach that ensures corporations are managed consistently on value. VBM is dependent on the corporate purpose and the corporate values. As noted, the corporate purpose can either be economic (shareholder value) or can also aim at other constituents directly (stakeholder value). Evidence reveals that, under the culture of VBM, employees can make better decisions with authorization and work more efficiently in their team due to the complete devotion, risk taking, and sharing of ownership of work by each employee. The VBM can, therefore, combine employees' interests with value and profit/loss in business. Furthermore, the improper value management cannot provide the entity with clear objective direction. Thereafter, in order to maintain long-term business value, decision makers should realize the correct direction and coming challenges for the enterprise (Kelso and Adler, 1958). According to the analysis and mock demonstration in this article, industries or even firms can more closely understand their strengths and weakness in the practice of VBM and, thus, frame ways for future improvement in order to assure sustainable business value.

Attributes of intangible assets

Our empirical research reflects that intangible asset attributes that technology industries emphasize are different. For example, integrated circuit, communication, computer and peripherals, optoelectronic, and precision machinery industries think highly of "key technology," "R&D capability," and "employee R&D" criterion so as to accord with the characteristics of pursuing innovation and fast development in high-technology industries. Biotechnology industry, on the other hand, considers the criterion of "asset management capability," "operation quality capability," "technology update capability," "patents," and "employee R&D" critical because the industry faces higher R&D risks and uncertainty. However, most of the technology industries through our survey reveal that their "key technology" is the intangible asset criterion of the first or second rank. As a result, the dimensions and criterion of this research model can be viewed as a character reference of evaluating the high-technology intangible assets. More importantly, the value weights are coordinated with the attributes and needs of each industry in order to achieve diversity and solidity in appraising the intangible assets. Besides, the referred weights can help an entity formulate decisions for the purposes of mergers and acquisitions, and as noted, with the addition of the calculation of economic value-added (EVA) of business, the genuine intangible asset values can be more completely valuated.

Support of business evaluation

Suppose that a given company has an intangible value estimated through the market and the book value of its assets. For investment purposes, the estimate of the intangible is important to the negotiating processes, such as in mergers and acquisitions, and to the decision of the stock market investments. This is due to the fact that, usually, the inability of the merging price to reflect the genuine value of the merged firm comes from the simple concern of the company book value instead of covering the intangibles. However, to the company's managerial purposes, it is significant to perform not only the analysis of the intangible value, but also to identify the value drivers. Therefore, the management may be able to set the company's strategies and to improve and explore its competitive advantages. With the use of weight structure delivered by the AHP method applied in this article, the merged firm can carry out the self-evaluation, which can assist in traditional financial valuation, in order to proceed with a win–win situation for both sides of the merger case by reaching a more reasonable merging price.

Future research directions

In spite of the fact that our research model cannot thoroughly resolve all problems of intangible asset

evaluation, none of the related literatures reach the consensus of the evaluation method. Nevertheless, the appraising model of intangible assets constructed by this research, which is based on multi-level and multi-criterion methods and with the approval of 118 professional executives, is said to be useful as a temporary reference for technology industries to plan and execute their intangible asset evaluation. On the other hand, it is advisable to expand the industry domain in future research, such as the comparison of intangible attributes and formations between technology industry and conventional industry; moreover, we can even make transnational comparisons, for instance, in terms of the same industry between nations. Do national policies or competitiveness have impacts on the relative weights of these intangible value drivers? If the answer is yes, what are the intents of the influence? These issues deserve further discussions and exploration in the future.

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