
Evaluated weights affecting financial performances' key factors: As exemplified with listed IC design corporations in Taiwan

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Abstract

This study aims to evaluate the weight of the key factors that influence financial performances of IC design houses listed in Taiwan. Three typical IC design houses listed in Taiwan are sampled. This paper applies Analytic Network Process (ANP) to analyze the relationship between criteria, and identify the priorities of individual criteria and the rankings of respective weights. The results suggest that the R&D capability is rated by both scholars and businesses at over 0.2 for listed IC design houses in Taiwan. Marketing innovation, intellectual capital accumulation and corporate governance are all assigned with a weighting of more than 0.1 by scholars and businesses. In other words, both scholars and businesses agree that R&D capability, marketing innovation, intellectual capital accumulation, corporate governance, and IT applications are critical to the financial performances of IC design houses listed in Taiwan. R&D capability is of particular importance. The analysis and findings can serve as a reference to the managers of IC design houses listed in Taiwan in the day-to-day business decisions and the understanding of the priority or importance of key factors to financial performances.

Keywords: Financial performance, analytic network process (ANP), listed IC design houses

Introduction

IC design is at the forefront of the semiconductor supply IC chain, which also includes IC manufacturing, packaging, testing and support. The technological competences and capacity of IC design is critical to the development of the semiconductor industry in Taiwan. Hence, the

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production factors contributing to technological efficiency are essential to operating performances of the industry.

The semiconductor industry is important to the economic development of a country. It is highly capital- and technology-intensive. Among the countries with a leading position in semiconductors, Taiwan is the only country with a vertically integrated supply chain. The government seeks to boost the productivity of the industry by establishing science parks and creating cluster effects. In fact, Taiwan is the role model for the countries who seek to develop their semiconductor industries. The semiconductor industry in Taiwan is known for unparalleled competitiveness in efficiency and cost due to a comprehensive supply chain. This also provides an ideal backdrop for the booming development of IC design houses (Peng, 2009; Chen and Lee, 2012).

According to Chuang (2004), robust corporate governance can prevent and reduce agency costs. The establishment of corporate governance and monitoring mechanisms can maximize firm interests and enhance organizational performances. Zheng (2008) indicated that corporate governance has positive and significant influence over performances. Further examinations are required in terms of the level of such influence.

Given its high capital-intensive nature, companies in the semiconductor industry have to accumulate intellectual capital to better organizational performances in the rapidly changing knowledge-based economy. Intellectual capital can create high value for companies and generate a competitive edge as the core for firm survival (Chiang, 2006).

Customers' satisfaction is the top priority in the 21st century. Customers hope to quickly receive customized products for a reasonable price. As a result, the business model with a focus on mass production is affected and replaced by flexible and rapid responses to customer needs. Mass customization becomes the new business model for manufacturers offering customized products in large varieties at reasonable prices (Wang, 2004). Lee *et al.* (2013) suggested that large customization by listed optoelectronics companies has significance impact on firm performances.

Yang (2007) explored marketing innovation and argues that product innovation has positive effects on organizational performances. In terms of the studies on organizational changes, cultural shifts and organizational performances, Wu (1984) proposed the application of intervention techniques to drive necessary transformations in an organization, so as to improve work effectiveness of individuals and groups, as well as the overall effectiveness of the organization. Liu (2004) also mentioned that good organizational cultures contribute to the improvement of organizational effectiveness and productivity.

Chen (2004) referred to productivity as an indicator to firm performances to re-examine the relationship between the holdings by institutional investor and operating performances of companies. The results suggest that productivity is a better measure of firm performances compared to Tobin's Q. Meanwhile, there is a significant and positive correlation between the percentage of institutional holdings and the operating performance of companies. Hence, this paper believes that R&D capability of IC design houses can boost firm productivity and organizational performances. Further studies are required to gauge the effects on the performances of IC design houses.

As far as the effects of IT investments on organizational performances, Katz (1993) indicated that IT contributes to firm competitiveness by lowering overall costs, improving productivity, receivables, response time to customers and transactions and hence division performances. Chen (2001) also contended that IT applications boast positive and significantly influence on business performances. Further studies are warranted to evaluate the effects on the performances of IC design houses.

Based on the above-mentioned research motivations, this paper samples three typical listed IC design houses in Taiwan and focuses on the relationship between organizational performances and (1) corporate governance; (2) accumulation of intellectual capital; (3) marketing innovation; (4) organizational changes and cultures; (5) flexible manufacturing; (6) R&D capabilities; and (7) IT applications. The purpose is to establish a research structure for the analysis and the evaluation of the weights of key factors of financial performances of the listed IC design houses in Taiwan.

Literature review

After referring to domestic and overseas literature on the key factors concerning financial performances, this paper summarizes the following list of sub-dimensions: (1) corporate governance; (2) accumulation of intellectual capital; (3) marketing innovation; (4) organizational changes and cultures; (5) flexible manufacturing; (6) R&D capabilities; and (7) IT applications.

Relationship between corporate governance and organizational performances

Yermack (1996) suggested that a small board is less effective than a large board. In other words, there is a positive correlation between board sizes and Tobin's Q. Meanwhile, the higher the holdings by external directors or the greater the percentage of external directors in the board, the higher the firm values. This indicates the independent monitoring and supervision functions of external directors contribute to the efficiency of company decisions.

Hung (2006) indicated for both affiliated and non-affiliated companies, institutional investors' ownership and good corporate governance have significantly positive influence on firm performances. In fact, the holdings by foreign institutional investors are the most important factor. Wang (2006) argued that equity ownership profiles and board structures are critical to firm values. Good corporate governance attracts investors because it ensures reasonable returns on invested capital. Hence, corporate governance boasts positively significant influence on performances (Zheng, 2008).

Relationship between intellectual capital accumulation and organizational performances

Wang (2008) in his paper, "Evaluation of the Drivers of Financial Performance from the viewpoint of Intellectual Capital: Evidence from the Taiwanese IT Industries" indicates that organizational capital boasts no direct explanatory power over financial performances. Rather, human capital and customer capital report direct influence on financial performances. This paper expects organizational capital to have partial effects on value creation in terms of financial performances via human capital, customer capital and relationship capital.

Peng (2009) conducted case studies as part of an in-depth exploration on the relationship between the contributing factors of knowledge management and knowledge management. The purpose is to further delve into the process in which organizations accumulate intellectual capital via knowledge management in order to boost organizational performances.

Tseng and Hu (2010) indicated that intellectual capital consists of human capital, structural capital and social capital. Organizations are advised to develop human capital, which is difficult for competitors to copy. The accumulated intellectual capital and capabilities are transformed into core competences of the organization. The utilization of structure capital can create the uniqueness of the organization and establish externalities not possible to be replaced. This enhances the social capital of the organization. The synergies resultant from the interaction of human capital, structural capital and social capital are the key to the organizational competitiveness.

Chen (2011) said in her paper, "The Relevance between Intellectual Capital, Business Strategy and Financial Performance in Taiwan's Information Technology Industry" that intellectual capital exhibits significant influence on financial performances.

Dang (2011) indicated in his paper, "Effects of Corporate Social Responsibility and Intellectual Capital on Corporate Financial Performance: A Path Analysis Model" that intellectual capital factors have positive inter-relationships and report positive effects on financial performances of companies.

Relationship between marketing innovation and organizational performances

Huang (2002) argued in his paper, “Knowledge Management, Innovative Strategic, Organization Performance — Taiwan Integrated Electronic Circuit Products” that the innovation of marketing techniques has positive effects on organizational performances.

Yang (2007) examined the innovation of marketing techniques and indicates that product innovations boast mediating effects on the relationship between market-orientation behavior, product innovations, and organizational performances. He also delves into the relationship among these factors, and the research suggests that product innovations create positive effects on organizational performances.

Relationship between organizational changes/cultures and organizational performances

Wu (1984) advocated the application of practical techniques for intervention in order to drive necessary changes in an organization. This enhances the job effectiveness of individuals and groups, as well as the overall effectiveness of the organization.

Tseng (2006) said that organizational cultures are the expression of shared beliefs and expectations within an organization.

Daft (2006) believed that organizational cultures are the core values, beliefs, thinking and behavior criteria shared by all members of an organization.

Liu (2004) indicated that good organizational cultures can boost organizational effectiveness and productivity.

Relationship between flexible manufacturing and organizational performances

Kuo (1998) held that good flexible design in route planning of the manufacturing systems can smooth manufacturing procedures and enhance system performances.

Chen (2000) contended that output flexibility demonstrates different degrees of significant contributions to profitability and sales growth. For example, output mobility and flexibility contribute significantly and positively to profit margins.

Relationship between R&D capabilities and organizational performances

Lin, *et al.* (2007) indicated that the improvement of technical efficiency can dramatically boost ROA, ROE and P/E multiples.

Chen (2004) used productivity as an indicator to firm performances to re-examine the relationship between the holdings by institutional investor and operating performances of companies. The results show that productivity is a better measure of firm performances compared to Tobin's Q. In addition, there is a significantly positive correlation between the percentage of institutional holdings and the operating performance of companies. Hence, this paper believes that R&D capability of IC design houses can boost firm productivity and organizational performances.

Relationship between IT applications and organizational performances

Kaplan & Norton (1992) addressed these issues from financial perspectives and indicate that IT investments are positively correlated with market shares, ROE, cash flows and sales growth of companies.

Katz (1993) believed in the positive contributions of IT to firm competitiveness, such as reduction in total costs and improvement in productivity, receivables, response time to customers and transactions and divisional performances.

Chen (2001) contended that IT applications have positive and significant influence on organizational performances.

Research methodology and design

Analytic network process (ANP)

ANP is an extension of AHP (Analytic Hierarchy Process) with the addition of a feedback mechanism. The purpose is to accurately capture and predict the internal relationships among all the criteria, goals and proposals via ratio scales, so as to achieve optimal decisions (Mohamed, 2002; Chen, 2004). This paper applies the ANP method in the analysis of the relationships among the green design criteria and seeks to identify the relative weights and importance rankings of individual criteria. The analytical findings during this stage can serve as a reference to decision-makers of the listed IC design houses in Taiwan regarding the priority and importance of key factors of financial performances and the strategic decisions over business management.

The decision rules in ANP networks comprise of clusters, elements, nodes and links. If a node in a given cluster exhibits interdependence or feedback relationships with a node in another cluster, there will be connecting link between these two clusters. ANP assumes and allows the interdependence or feedback relationships among elements within the same or across different decision criteria. If such interdependence or feedback relationships are within the same decision criteria, it is considered "inner dependence". In the absence of any inner dependence, the node in

the same criterion should be compared pair-wise with the node in another criterion. The interdependence or feedback relationship between elements in different decision criteria is called “outer dependence” (Saaty, 1996). The permission of interdependence or feedback relationships across criteria is in line with the actual situation of tackling complex issues in the human society. This is particularly true when the uncertainties and risks are involved in the decisions in question (Sun, 1997; Liu, 2002; Tu and Hsu, 2008).

The ANP model is suitable to solve the problems whose structures may contain one or multiple networks. The construction of the network applicable to the ANP model should take the following issues: (1) whether the classification of elements and clusters are required for problem solving; (2) the establishment of a cluster takes precedence of nodes (elements); (3) it is necessary to select a node (element) as the parent node and examine whether other nodes in the cluster are affected by the parent node. The affected nodes are “children nodes”. The children nodes are compared pair wise in order to determine the effects of parent node. This is followed by the selection of another parent node accordingly; (4) The plotting of the links between the children nodes subject to the influence of the parent node is required for the pair wise comparisons of these nodes; (5) The establishment of the links describing the relationships among all the nodes marks the completion of the links between clusters; (6) finally, it is necessary to confirm the accuracy of the links for the influencing nodes and the influenced nodes to facilitate the pair wise comparisons of nodes to nodes and clusters to clusters.

The calculation of the ANP network requires three matrixes, i.e. un-weighted super-matrix, weighted super-matrix and limit super-matrix. The un-weighted matrix consists of the weights based on pair wise comparisons in the original network. The weighted matrix is constructed by multiplying the component weight with relevant cluster weight in the un-weighted matrix. If the values in the straight column add up to 1 (stochastic) in the un-weighted matrix, the weighted matrix is equivalent to the un-weighted one.

The limit matrix is established by making the weighted matrix multiplying itself until all the values in the straight column become equal. In other word, the weight of any individual node in the network can be obtained from any of the straight columns. According to the calculation method developed by Saaty (1996) for the ANP model, if the limit matrix is irreducible, $\lim SV = [w... w]$. At this juncture, all the straight columns in the matrix will be identical and equivalent to vector w , and hence converge (Tu and Hsu, 2008). Simply put, the ANP methodology comes in the following stages: (1) the application of the Delphi method or interviews with experts to establish a hierarchical network for the assessment desired; (2) the calculation of the weights for individual elements in the hierarchical levels, such as the establishment of pair wise comparison matrixes (by

issuing questionnaires), the computation of Eigen values and vectors, consistency tests (<0.1) and calculation of super/limit matrixes; and (3) the calculation of global weight for all the hierarchical levels (Hu and Wang, 2008).

Questionnaire design

According to the research structure, this paper establishes the connection between the financial performance dimensions of listed IC design houses in Taiwan and the criteria in the ANP model. The analytical figure of the ANP model is referred to for the design of the questionnaire aiming to evaluate the inter-relationships between criteria of the financial performance dimensions of the listed IC design houses in Taiwan. The ANP method is suitable for the data collection via the interviews with a small sample of experts. This paper conducts interviews with experts well-versed in the issues associated with the typical three IC design houses listed in Taiwan in order to understand the perceived importance of individual criteria of the financial performance dimensions for these companies.

Research targets

This paper issues questionnaires to the following experts:

- (1) A total of 6 questionnaires released to scholars and a total of 5 questionnaires recovered, with an effective recovery rate of 83%;
- (2) A total of 9 questionnaires released to scholars and a total of 8 questionnaires recovered, with an effective recovery rate of 89%.

The high effective recovery rate of the questionnaires is the result of convenience sampling.

Research structure

The following tables 1, 2 and 3 are to respectively summarize (1) the evaluation structure of financial performances of IC design houses listed in Taiwan; (2) the dimensions and definitions of financial performances of IC design houses listed in Taiwan; and (3) the relationships among sub-dimensions.

Table 3 shows that the sub-dimensions are not entirely independent from each other and some of them are interrelated. In other words, the pair wise comparisons of nodes to nodes and clusters to clusters indicate that nodes or clusters are not completely independent from each other; therefore, this paper uses the ANP method to replace AHP (Hu and Wang, 2008).

Table 1: Evaluation structure of financial performances of IC design houses listed in Taiwan

Goals	Sub-dimension	Criteria
Financial performances (FP)	Corporate governance (C)	The company is good at earnings management (C1). The company has a solid capital structure (C2). The company has a good relationship with stakeholders (C3). The qualities of the board are superior to that of other companies (C4).
	Intellectual capital accumulation (IP)	The employees are uniquely creative (IP1). The knowledge and skills of the employees are sufficient to solve work problems (IP2). The company is able to quickly develop new products to meet market demands (IP3). The company maintains a close relationship with companies from the upper stream to the downstream of the supply chain (IP4).
	Marketing innovation (IM)	The company adopts leading techniques (IM1). The marketing campaigns of the company are often followed by others (IM2). The marketing activities of the company are more innovative than those of others (IM3).
	Organizational changes and cultures (OC)	The company is able to fine tune organizational structures in response to changes of the external environments (OC1). The company has set up a definite hierarchy and division of responsibilities (OC2). The employees of this company are creative (OC3). The employees of the company help each other and collaborate to complete tasks (OC4). The company often provides incentives and encouragement to employees (OC5).
	Flexible manufacturing (F)	Production comes with mix flexibility (F1). Output comes with volume flexibility (F2). The company boasts delivery time flexibility (F3). The company maintains market flexibility (F4).
	R&D capabilities (R)	The company is able to rapidly develop new products to satisfy market needs (R1). The company has built comprehensive databases for inquiries (R2). The annual R&D spending is above the industry average (R3).
	IT applications (IT)	The employees are IT- savvy (IT1). The employees rely on computers very much (IT2). The company connects internal work flows with technology (IT3).

Table 2: Dimensions and definitions of financial performances of IC design houses listed in Taiwan

Dimension	Definition	Reference
Corporate governance (C)	Focus on the effective monitoring of organizational activities and the establishment of robust operations via legal designs in the companies where ownership and management are segregated, so as to prevent management problems and unscrupulous behaviour. From the economic perspectives, corporate governance aims to maximize the economic value of a firm, i.e. the maximization of returns to shareholders, creditors and employees; from the financial management perspectives, corporate governance aims to ensure managers to utilize capital in the optimal manner so as to earn the deserved returns.	Lu (2004)
Intellectual capital accumulation (IP)	Covering all the skills, knowledge, information, experience, the capability and wisdom in problem-solving that a company has integrated into the human capital, structural capital and intellectual capital.	Chen (2001); Chen and Lee (2012)
Marketing innovation (IM)	Innovation of products and marketing techniques	Lee, Wang and Chang (2011)
Organizational changes and cultures (OC)	To survive and pursue sustainable developments, organizations have to change and adjust according to the evolution of internal and external environments. Internal adjustments include the change of attitudes and behaviour of employees and the improvement of organizational cultures. External adjustments aim to establish organizational advantages, so as to achieve steady growth and performance improvements.	Lee, Chang, and Lin (2012)
Flexible manufacturing (F)	Ability to lower costs and shorten lead -time in the face of environmental uncertainties so as to ensure rapid responses to changes.	Wang (2004)
R&D capabilities (R)	R&D capabilities of the R&D department.	Chen and Lee (2012)
IT applications (IT)	Application of computers, software, data and storage technologies	Laudon & Laudon (2000)

Table 3: Relationships among sub-dimensions

Dimension		C				IP				IM			OC				F				R			IT		
Criteria		C1	C2	C3	C4	IP1	IP2	IP3	IP4	IM1	IM2	IM3	OC1	OC2	OC3	OC4	F1	F2	F3	F4	R1	R2	R3	IT1	IT2	IT3
Dimension/Criteria																										
C	C1	X	X	X	X	V	V	V	V	V	V	V	V	V	V	V	X	X	X	X	X	X	X	X	X	X
	C2	X	X	X	X	V	V	V	V	V	V	V	V	V	V	V	X	X	X	X	X	X	X	X	X	X
	C3	X	X	V	V	V	V	V	V	V	V	V	V	V	V	V	X	X	X	X	X	X	X	X	X	X
	C4	X	X	V	V	V	V	V	V	V	V	V	V	V	V	V	X	X	X	X	X	X	X	X	X	X
IP	IP1	V	V	V	V	X	X	X	X	V	V	V	X	X	X	X	X	X	X	X	V	V	V	V	V	V
	IP2	V	V	V	V	X	X	X	X	V	V	V	X	X	X	X	X	X	X	X	V	V	V	V	V	V
	IP3	V	V	V	V	X	X	X	X	V	V	V	X	X	X	X	X	X	X	X	V	V	V	V	V	V
	IP4	V	V	V	V	X	X	X	X	V	V	V	X	X	X	X	X	X	X	X	V	V	V	V	V	V
IM	IM1	V	V	V	V	V	V	V	V	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	IM2	V	V	V	V	V	V	V	V	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	IM3	V	V	V	V	V	V	V	V	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
OC	OC1	V	V	V	V	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	OC2	V	V	V	V	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	OC3	V	V	V	V	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	OC4	V	V	V	V	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
F	F1	X	X	X	X	X	X	X	X	X	X	X	V	V	V	V	X	X	X	X	V	V	V	V	V	V
	F2	X	X	X	X	X	X	X	X	X	X	X	V	V	V	V	X	X	X	X	V	V	V	V	V	V
	F3	X	X	X	X	X	X	X	X	X	X	X	V	V	V	V	X	X	X	X	V	V	V	V	V	V
	F4	X	X	X	X	X	X	X	X	X	X	X	V	V	V	V	X	X	X	X	V	V	V	V	V	V
R	R1	X	X	X	X	V	V	V	V	X	X	X	X	X	X	X	V	V	V	V	X	X	X	V	V	V
	R2	X	X	X	X	V	V	V	V	X	X	X	X	X	X	X	V	V	V	V	X	X	X	V	V	V
	R3	X	X	X	X	V	V	V	V	X	X	X	X	X	X	X	V	V	V	V	X	X	X	V	V	V
IT	IT1	X	X	X	X	V	V	V	V	V	V	V	X	X	X	X	V	V	V	V	V	V	V	X	X	X
	IT2	X	X	X	X	V	V	V	V	V	V	V	X	X	X	X	V	V	V	V	V	V	V	X	X	X
	IT3	X	X	X	X	V	V	V	V	V	V	V	X	X	X	X	V	V	V	V	V	V	V	X	X	X

Note: 1. Please refer to “straight” columns for inputs. 2. Please refer to “horizontal” rows when plotting in a Word document. 3. C: corporate governance; IP: intellectual capital accumulation; IM: marketing innovations; OC: organizational changes and cultures; F: flexible manufacturing; R: R&D capabilities; IT: IT applications.

ANP analytical procedures

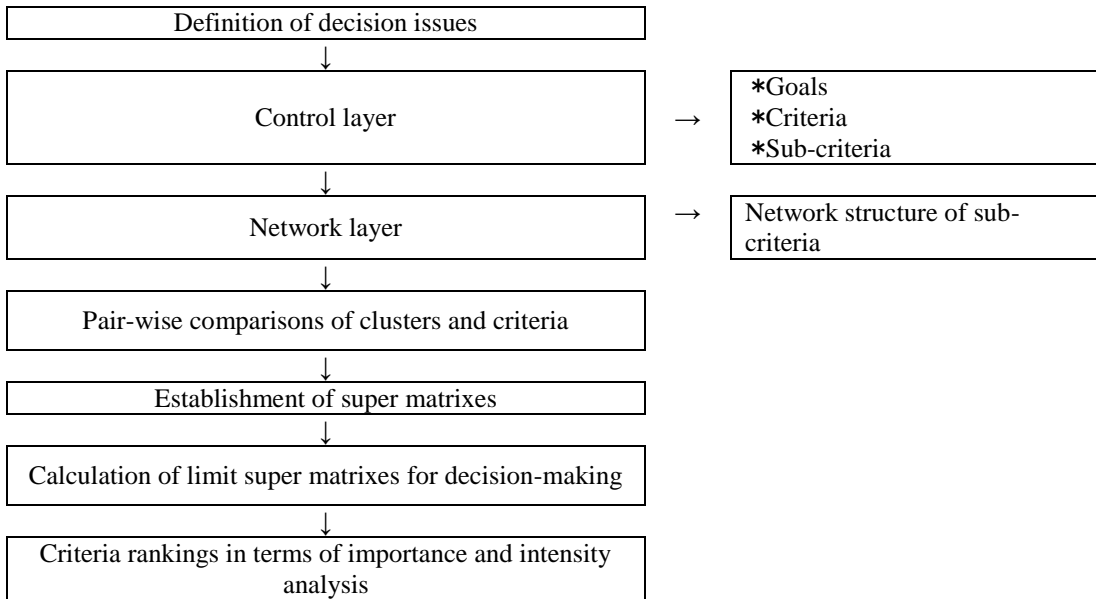


Figure 1 Analytical procedures

Figure 1: Illustrates the ANP procedures for the analysis

(1) Construction of Decision-Making Systems

The first step in the ANP methodology is to divide the system into two parts. The first part is the control level, consisting of goals, criteria and sub-criteria. All the decision criteria are considered independent and only subject to the dominance of goal elements. There may not be decision criteria among the control factors but there will be at least a goal. The weight of each criterion in the control level can be obtained with the traditional AHP approach. The second part is the network level, composed of clusters or components subject to the dominance of the control level. Inside the network level is the structures that influence each other.

(2) Pair wise comparisons of individual clusters and criteria

After the construction of the decision-making system and the feedback relationships in Step (1), pair wise comparisons are made on the clusters, criteria and clusters/criteria with feedback relationships in the same manner as the AHP method.

(3) Establishment of super matrixes

After the pair wise comparisons on the clusters and criteria described in Step (2), the feature vector of individual criteria in the control level can be calculated with the AHP method. All the feature vectors are expressed in the form of super matrixes.

If the normalized vectors in the super matrix add up to 1, it is called “stochastic matrix” or “weighted super matrix”; if not, it becomes an un-weighted super matrix. The advantage of a stochastic matrix is that the maximum Eigen-value is 1, making the calculations easier.

(4) Calculation of limit super matrixes for decision-making

Step (3) classifies the super matrixes into different types on the basis of Eigen-values. The next step is to multiply the weighted super matrixes to derive limit super matrixes. Different system structures result in the calculations for different super matrixes (decomposable, non-decomposable, basis and non-basis).

(5) Criteria rankings in terms of importance and intensity analysis

The final step is to rank the criteria based on weights and conduct an analysis on intensity of the financial performance dimensions of IC design houses listed in Taiwan.

Research findings and conclusions

According to the research structure, this paper conducts the ANP model of the financial performance dimensions of the IC design houses listed in Taiwan and establish the connections between criteria. The analytical figure for the ANP model serves as a basis for the design of the questionnaire on the interrelations among the criteria of financial performance dimensions of IC design houses listed in Taiwan. This paper conducts interviews with experts concerning the three sampled companies so as to understand the emphasis placed by these experts regarding the relative importance of individual criteria of the financial performance dimensions of IC design houses listed in Taiwan. The answers to the questionnaires are translated into values and the geographic means of respective criteria are computed. Finally, the software package for ANP analysis, Super Decisions, is run to rank the criteria concerned in order of importance, and these rankings can be effectively in the assessment of the finance performance dimensions of IC design houses listed in Taiwan.

Tables 4 and 5 summarize the CI values, weights and rankings of the financial performance dimensions and criteria of IC design houses listed in Taiwan according to the feedback from scholars and businesses.

Table 4: CI values, weights and rankings of financial performance dimensions according to feedback from scholars and businesses

Overall dimension	CI value		Sub-dimension	CI value		Weight		Ranking	
	Scholars	Businesses		Scholars	Businesses	Scholars	Businesses	Scholars	Businesses
Financial performances	0.01	0.01	Corporate governance (C)	0.00	0.00	0.161	0.162	4	4
			Intellectual capital accumulation (IP)	0.00	0.01	0.182	0.183	3	3
			Marketing innovations (IM)	0.01	0.01	0.221	0.222	2	2
			Organizational changes and cultures (OC)	0.00	0.00	0.063	0.052	6	7
			Flexible manufacturing (F)	0.00	0.00	0.060	0.055	7	6
			R&D capabilities (R)	0.01	0.02	0.231	0.233	1	1
			IT applications (IT)	0.00	0.00	0.082	0.093	5	5

Table 4 shows that the CI values based on the reviews from scholars and businesses are all smaller than 0.1 as proposed by Saaty for the overall dimensions and sub-dimensions (Hu and Wang, 2008).

According to the reviews by scholars, the sub-dimensions in the order of importance are R&D capabilities, marketing innovations, intellectual capital accumulation, corporate governance, IT applications, organizational changes and cultures and flexible manufacturing. The sub-dimensions in the order of importance rated by businesses are R&D capabilities, marketing innovations, intellectual capital accumulation, corporate governance, IT applications, flexible manufacturing and organizational changes and cultures.

It is worth noting that the order of flexible manufacturing and organizational changes and cultures is exactly opposite in the two lists made by scholars and businesses. This is because scholars rating the criteria from theoretic or rational perspectives and businesses rank these criteria based on practical experiences. Both scholars and businesses assign a weighting of more than 0.2 to R&D capabilities, a weighting of more than 0.1 to marketing innovations, intellectual capital accumulation and corporate governance. The weighting for IT applications, organizational changes and cultures and flexible manufacturing are less than 0.1 based on the feedback from scholars and businesses.

Table 5: Weights and rankings of criteria as financial performance dimension according to ratings by scholars and businesses

Sub-dimension	Criteria	Weight		Ranking	
		Scholars	Businesses	Scholars	Businesses
Corporate governance (C)	Good in earnings management (C1)	.261	.213	2	3
	Solid capital structure (C2)	.334	.331	1	1
	Good relationship with stakeholders (C3)	.221	.252	3	2
	Qualities of the board superior to those of other companies (C4)	.184	.204	4	4
Intellectual capital accumulation (IP)	Employees equipped with unique creativity (IP1)	.281	.284	2	2
	Knowledge and skills of employees sufficient to resolve work issues (IP2)	.352	.351	1	1
	Ability to quickly develop new products to meet market needs (IP3)	.214	.201	3	3
	Close relationships with suppliers/clients from upper to down stream (IP4)	.153	.164	4	4
Marketing innovations (IM)	Adoption of leading techniques (IM1)	.256	.362	3	2
	Marketing campaigns often copied by other companies (IM2)	.351	.247	2	3
	Marketing activities more innovation than those of other companies (IM3)	.393	.391	1	1

Organizational changes and cultures (OC)	Ability to swiftly adjust organizational structures in response to changes of external environments (OC1)	.264	.253	1	1
	Definite hierarchy and division of responsibilities (OC2)	.192	.221	3	2
	Creative employees (OC3)	.173	.172	4	4
	Employees helping each other to accomplish tasks (OC4)	.140	.184	5	3
	Employees given incentives and encouragement (OC5)	.231	.170	2	5
Flexible manufacturing (F)	Mix flexibility in production (F1)	.203	.221	4	3
	Volume flexibility in output (F2)	.222	.213	3	4
	Delivery time flexibility (F3)	.311	.313	1	1
	Market flexibility (F4)	.264	.253	2	2
R&D capabilities (R)	Ability to quickly develop new products to satisfy market needs (R1)	.561	.553	1	1
	Construction of comprehensive databases for inquiries (R2)	.312	.311	2	2
	Annual R&D spending above industry average (R3)	.127	.136	3	3
IT applications (IT)	IT- savvy at work (IT1)	.281	.321	2	2
	Heavy reliance on computers for work (IT2)	.146	.108	3	3
	Close integration of internal procedures with technologies (IT3)	.573	.571	1	1

Below is a discussion of the financial sub-dimensions listed in Table 5.

(1) Corporate Governance

Both scholars and businesses think that the criterion “solid capital structure” is the most important sub-dimension under corporate governance. “Qualities of the board superior to those of other companies” is ranked at the bottom of the list.

(2) Intellectual Capital Accumulation

Among the sub-dimensions under “intellectual capital accumulation”, scholars and businesses share the same review regarding the importance ranking of criteria. They all agree that “knowledge and skills of employees sufficient to resolve work issues” is the most important criterion, followed by “employees equipped with unique creativity”.

(3) Marketing Innovations

Both scholars and businesses consider “marketing activities more innovation than those of other companies” the most relevant criterion under the sub-dimension “marketing innovations”. However, their views concerning “adoption of leading techniques” and “marketing campaigns often copied by other companies” are exactly the opposite. This may be a result of the theoretic grounds taken by scholars and the practical perspectives businesses are coming from.

(4) Organizational changes and cultures

Both scholars and businesses regard “ability to swiftly adjust organizational structures in response to changes of external environments” as the most important criterion under the sub-dimension “organizational changes and cultures”. Their views are different when it comes to the other four criteria, “definite hierarchy and division of responsibilities”, “creative employees”, “employees helping each other to accomplish tasks” and “employees given incentives and encouragement”.

(5) Flexible manufacturing

Both scholars and businesses agree that “delivery time flexibility” is the most important criterion, followed by “market flexibility” under the sub-dimension “flexible manufacturing”. Their views are exactly the opposite with regards to the criteria “mix flexibility in production” and “volume flexibility in output”.

(6) R&D capabilities

Scholars and businesses share the same view concerning the rankings of the criteria in the order of importance under the sub-dimension “R&D capabilities”. They all think that the criterion “ability to quickly develop new products to satisfy market needs” is the most important, followed by “construction of comprehensive databases for inquiries” and then “annual R&D spending above industry average”.

(7) IT applications

The opinions from scholars and businesses are consistent with regards to the rankings of the criteria in terms of relative importance under the sub-dimension “IT applications”. They all believe that “close integration of internal procedures with technologies” is the most important criterion.

Research conclusions and follow-up studies

Conclusions

The ANP analysis yields the following results:

Sub-dimensions

Scholars rank the importance of sub-dimensions as R&D capabilities (0.231), marketing innovations (0.221), intellectual capital accumulation (0.182), corporate governance (0.161), IT applications (0.082), organizational changes and cultures (0.063) and flexible manufacturing (0.060).

Businesses rank the importance of sub-dimensions as R&D capabilities (0.233), marketing innovations (0.222), intellectual capital accumulation (0.183), corporate governance (0.162), IT

applications (0.093), flexible manufacturing (0.055) and organizational changes and cultures (0.052).

According to the ratings by scholars and businesses, the sub-dimension “R&D capabilities” for IC design houses listed in Taiwan are assigned with a weighting of over 0.2. The weighting for “marketing innovations”, “intellectual capital accumulation” and “corporate governance” is higher than 0.1. In other words, both scholars and businesses believe that R&D capabilities, marketing innovations, intellectual capital accumulation, corporate governance and IT applications are key dimensions for the financial performances of IC design houses listed in Taiwan. R&D capabilities are considered the most important sub-dimension.

Criteria

(1) Corporate governance

Both scholars and businesses think that “solid capital structure” is the most important sub-dimension of corporate governance (scholars: 0.334; businesses: 0.331). “Qualities of the board superior to those of other companies” is rated as the least important (scholars: 0.184; businesses: 0.204).

(2) Intellectual capital accumulation

Scholars and businesses agree with the ranking of important criteria under the sub-dimension “intellectual capital accumulation”. They are consider “knowledge and skills of employees sufficient to resolve work issues” the most important criterion (scholars: 0.352; businesses: 0.351), followed by “employees equipped with unique creativity” (scholars: 0.281; businesses: 0.284).

(3) Marketing innovations

Both scholars and businesses consider “marketing activities more innovation than those of other companies” the most important criterion under the sub-dimension “innovative marketing” (scholars: 0.393; businesses: 0.391). However, they have the exactly opposite view concerning “adoption of leading techniques” and “marketing campaigns often copied by other companies”. This may be a result of the theoretic focus by scholars and the practice perspectives from businesses.

(4) Organizational changes and cultures

Both scholars and businesses consider “ability to swiftly adjust organizational structures in response to changes of external environments” the most important criterion under the sub-dimension “organizational changes and cultures” (scholars: 0.264; businesses: 0.253). Their views differ regarding the other four criteria, “definite hierarchy and division of responsibilities”,

“creative employees”, “employees helping each other to accomplish tasks” and “employees given incentives and encouragement”.

(5) Flexible manufacturing

When it comes to the criteria under the sub-dimension “flexible manufacturing², both scholars and businesses think that “delivery time flexibility” is the most important (scholars: 0.311; businesses: 0.313), followed by “market flexibility”. Their views on “mix flexibility in production” and “volume flexibility in output” are quite the contrary.

(6) R&D capabilities

Scholars and businesses share the same views concerning the ranking of the criteria under the sub-dimension “R&D capabilities” in the order of importance. They all believe that “ability to quickly develop new products to satisfy market needs” is the most important criterion (scholars: 0.561; businesses: 0.553), followed by “construction of comprehensive databases for inquiries” (scholars: 0.312; businesses: 0.311) and then “annual R&D spending above industry average” (scholars: 0.127; businesses: 0.136).

(7) IT applications

Scholars and businesses hold the same opinions regarding the ranking of the criteria under the sub-dimension “IT applications” in the order of importance. They all think “close integration of internal procedures with technologies” is the most important criterion (scholars: 0.573; businesses: 0.571), followed by “IT savvy at work” (scholars: 0.281; businesses: 0.321) and “heavy reliance on computers for work” (scholars: 0.146; businesses: 0.108).

Research contributions

This paper applies the ANP method to evaluate the key factors that affect the financial performances of IC design houses listed in Taiwan. This is an innovative application of theories in the field of management and accounting. The results can serve as a reference to decision-makers in the IC design industry.

Suggestion to follow-up studies

(1) The application of the ANP method with interviews with experts for data collection and the adoption of convenience sampling may be considered an overly “subjective” approach in data gathering. This is the biggest restriction in this paper. That said, as the literature review shows, many scholars resort to the same methodology in the assignment of weights to individual sub-dimensions not mutually independent or even the selection of proposals. In other words, scholars suggest that the ANP method is about the application of “Super Decisions”, a software

program” to process the interview data from a small sample of experts. Follow-up studies can still apply the same ANP method in case studies and management proposal evaluations.

(2) This paper only discusses the relationships between dimensions and criteria. Future studies may add proposal evaluations, or other research techniques such as gray correlation analysis.

Acknowledgement

For undertaking this research project I was helped by Takming University of Science and Technology, Taiwan. I much appreciate my university’s full support for providing me good research environment.

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