THE EFFECTS OF THE ACCUMULATION OF INTELLECTUAL CAPITAL ON ORGANIZATIONAL PERFORMANCE: USING PRODUCTIVITY AS THE MODERATOR

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ABSTRACT

The primary objective of this study is to verify the effects of the accumulation of intellectual capital on organizational performance of Taiwan-listed IC design houses; while using productivity as the moderator, and interviewing management staff of section-supervisor level and above of these design houses as the research subjects. The simple Random Sampling method is used to sample the population, while Structural Equation Modeling (SEM) is used to verify the overall research model and the fitting effects of its Structural Model and Measurement Model. The research results show that: concerning the effect of the intellectual capital accumulation of Taiwan-listed IC design houses on organizational performance, the "productivity" variable has a significant positive moderating or interactive effect, which also implies that productivity is a catalyst in the effect of intellectual capital accumulation on organizational performance of the Taiwan-listed IC design houses.

Keywords: Intellectual Capital, Organizational Performance, Productivity

INTRODUCTION

Intellectual capital value emerges gradually in the era of a knowledge-based economy, and highlights factors that are critical to business success and future long-term profitability. The importance of tangible assets to a business is gradually replaced by the importance of intangible assets in the era of a knowledge-based economy. Due to the concern over the reliability of information quality, conventional financial accounting practices ignore a number of important intangible assets for the sake of objectively measuring and faithfully representing transaction data (Chen, 2005). Therefore, more and more company-value items, such as patents, customer base, brands, and other such items, that cannot be listed on the balance sheet. The gradual rise in the value of intellectual capital in recent years highlights factors that are critical to business success and future long-term profitability.

Furthermore, while the semiconductor industry is important to the economic development of a country; it is highly capital-and-technology intensive. Among the countries with leading positions 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. Because the semiconductor industry in Taiwan has the unparalleled competitiveness in efficiency and cost, due to a comprehensive supply chain, it also provides an ideal backdrop for the booming development of IC design houses (Peng, 2009). While IC design is in the forefront of the supply chain, including IC manufacturing, packaging, testing, and support, of the IC industry, its technology and output dominate the development of the IC industry in Taiwan. Therefore, improving the
productivity factor of technical efficiency is relevant to the operating performance of the industry.

As mentioned above, since the semiconductor industry is a highly capital-intensive industry, if an enterprise wants to control the advantages presented in the rapidly changing era of a knowledge-based economy, it must improve its organizational performance through the accumulation of intellectual capital. Intellectual capital can create high enterprise value, bring forth the competitive advantages, and become its core competitiveness required for a company’s survival (Chiang, 2006). For more than a decade, a great deal of academic research was conducted on intellectual capital, which in itself proposes that intellectual capital may bring sustainable competitive advantages for businesses (Kaplan and Norton, 2004). In a broad sense, intellectual capital comprises human capital, social capital, and structural capital, and is considered a new mediating variable for interpreting a high performance work system and organizational performance (Becker and Huselid, 1998). With the use of high performance work systems in promoting and elevating human, structural, and social capitals of an organization, operational efficiency may be enhanced, thereby affecting the financial performance of an organization, and ultimately bringing forth improved business performance for the organization (Chang, 2010). Thus, to grab the advantage in a rapidly changing environment, an enterprise must enhance the accumulation of intellectual capital to ensure its sustainable operation and development. However, to know if improving both the accumulation of intellectual capital and productivity can generate interactive synergy on organizational performance of an enterprise is the motivation leading to this study and research.

Therefore, this study took Taiwan-listed IC design houses as the research subjects, constructed the research model and performed research verification on the basis of existing literature reviews, so as to understand the goodness-of-fit of the model's fitting effect. In other words, the specific purposes of this study are listed as follows:

1. To verify and understand whether the accumulation of intellectual capital has a significant positive effect on the organizational performance of Taiwan-listed IC design houses.

2. To verify and understand whether the productivity has a significant positive effect on the organizational performance of Taiwan-listed IC design houses.

3. To verify and understand whether the accumulation of intellectual capital has a significant positive interactive effect on the productivity of Taiwan-listed IC design houses.

LITERATURE REVIEW

This section is written for the understanding of research results of past scholars, and its relevance to this research topic. Research hypotheses were derived from and research framework was constructed on the basis of literature review. The theory and relevant research are described as follows:

The Accumulation of Intellectual Capital

Stewart (1997) published intellectual capital accumulation: the New Wealth of Organizations, a book loaded with case studies in a bid to explain the three elements of intellectual capital: human, structural and customer capitals. Stewart (1997) argued that intellectual capital includes these three types of capital and defined human capital as the sum of innovations, employees’ mindsets, seniority, turnover rate, work experiences, and learning ability; structural capital as the existing knowledge efficiently collected, tested, organized and integrated, with irrelevant components sifted out for further diffusion; customer capital as the way a specific organization deals with all relevant parties, which involves the satisfaction, retention rate and loyalty of customers.

In their book “Intellectual Capital Accumulation: Realizing Your Company’s True Value by Finding Its Hidden Brainpower” Edvinsson & Malone (1997) explained the intellectual capital implementation process and measurement indicators at Scandia Inc. They agreed that intellectual capital includes human, structural and customer capitals, with the human capital being the sum of personal competencies, knowledge, skills and experiences of a company’s entire staff and management, as well as the organization’s capabilities in creativity and innovation. Structural capital, they said, is a supportive framework and organized capacity that gives human capital a tangible form, authority and
support, including the palpable system for communicating and storing intellectual materials. The customer capital involves customer satisfaction, durability, price sensitivity, and the long-term customers’ financial conditions, the argued.

Intellectual capital, according to Sveiby (1998), is made up of individual competencies and the internal/external structure of a company, where “individual competencies” is defined as the employees’ capabilities of taking actions under varied circumstances with explicit knowledge, skills, experiences, value judgments, social networks, among others; the “internal structure” is defined as the sum of patents, concepts, patterns/models, computer and management systems; the “external structure”, the sum of company-customer or company-supplier relationships such as brands, goodwill, and trademarks.

Johnson (1999) addressed intellectual capital in three categories, namely the human, structural and relationship capitals, where “human capital” is defined as the combination of idea capital (or the labor force for knowledge-oriented tasks and employee aptitudes/attitudes) and leadership capital (or the personal qualities of an expert/manager); “structural capital” is defined as the combination of innovation capital (i.e., patents, trademarks, copyright and knowledge archives) and process capital (i.e., work procedures, trade secrets); “relationship capital”, the sum of a company’s relationships with customers, suppliers and online-community members.

While Knight (1999) tackled the issue of intellectual capital in four dimensions, namely human, structural and external capitals besides financial performance, the said human capital comprises the employee turnover rate, employee satisfaction, the number of new products/ideas conceived and recommended to be proposed/received; the structural capital comprises the operating-capital turnover rate, ratio of salespersons to general/administrative staff, and the length of time required to launch a new product; the external capital comprises customer persistency/satisfaction, the list of customers for maximum profitability, indicators of suppliers’ product quality/reliability; the financial performance comprises the Economic Value Added (EVA), the 90-day accounts receivable, and the value added per employee.

Dzinkowski (2000) suggested that intellectual capital comprises complex meanings, and is often synonymous with intellectual property, intellectual asset, and knowledge asset, and that it can be accumulated through capital, or is equal to a knowledge-based company procedure.

The intangible intellectual capital is a major referential indicator of enterprise value (EV), as contended by Chen (2001), who said intellectual capital consists of human, structural and relationship capitals while defining it as “something that integrates into such capitals all the skills, knowledge, information, experiences, problem-solving abilities and wisdom of a company.” She went on to define human capital as “the knowledge, skills and experiences of a company’s employees and management; structural capital, a company’s overall system/procedures concerning problem-solving and value creation”; relationship capital, “the initiation, maintenance and development of an organization’s external relationships with customers, suppliers, business partners, among others.”

Edvinsson (2003) gave a simple description of intellectual capital: something all businesses will rely on for future growth, as well as an indicator of efficiency in business operations. It is impossible to implement any corporate reform without first investing in intangible assets (Tsen and Hu, 2010).

Summarizing the above, the conceptual definition of this study concerning “Intellectual Capital” is drawn from Chen's (2001) definition: "That which encompasses the entire company and is expressed through skills, knowledge, information, experience, problem-solving capability and wisdom, and which is integrated in human capital, structural capital and relationship capital." Its operational definition is briefly described as follows:

(A) Human Capital: Knowledge, skills and experience of all employees and managers of the company.

(B) Structural Capital: The overall system and procedures that a company uses to solve problems and create values.
(C) Relation Capital: The establishment, maintenance, and development of external relationships of a company, including the relationships with customers, suppliers, and partners.

Organizational Performance

The Definition of Organizational Performance

Evans (1996) suggested that organizational performance is the measurement of the achievement level of an enterprise’s strategic objectives, and is also an indicator of overall enterprise competitiveness. An appropriate organizational performance assessment affords its manager the understanding of the status of the organization. Popular assessment indicators are income, productivity and profitability of the organization.

Xu (2007) suggested that "organizational performance" is divided into "efficiency" and "effectiveness". While, Drucker (1966) provided a very good interpretation for "efficiency" and "effectiveness", that Efficiency is "doing things right"; effectiveness is "doing the right things". Neither efficiency nor effectiveness should be neglected, but this is not to say that efficiency and effectiveness are equally important. For an organization, it is certainly preferable to improve efficiency and effectiveness at the same time; however, if both cannot be obtained, the organization should focus on effectiveness prior to aiming at improving efficiency.

The research of Lee, Chen and Lee (2013) suggested that the operational definition of organizational performance is that it is an indicator of the overall enterprise competitiveness, and it is also the measurement of the achievement level of an enterprise’s strategic objectives. While popular assessment indicators for organizational performance are income, productivity and profitability of the organization. Therefore, an appropriate organizational performance assessment affords its manager the understanding of the status of the organization.

Thus, "organizational performance" in this study is defined as the indicator for examining overall competitiveness of an enterprise, and is also used to measure the achievement of strategic goals of a business.

The Measurement Dimensions of Organizational Performance

There is a massive amount of previous studies addressing the measurement dimensions of organizational performance. Since the benefits of organizational performance will eventually be fed back to the financial dimension, most scholars in this field adopt financial performance as one of the measurement indicators. In an environment characterized by convenient ways of information delivery and rapid-changing markets, nevertheless, a company nowadays shall never solely rely on financial performance to achieve survival and competitiveness. That is to say, it is impossible to sufficiently gauge the organizational performance using financial performance as the single indicator.

To solve that dilemma, Kaplan and Norton (1996) suggested a BSC system comprising four dimensions: (1) the financial dimension; (2) the customer dimension; (3) the internal process dimension; (4) the learning and growth dimension. In their study Chow and Haddad (1997) also noted the value of BSC lies in the fact that it connects organizational strategies, frameworks and vision to create a set of corporate performance indicators for both traditional and modern companies. Meanwhile, the BSC method transforms a company’s long-term strategies/goals (e.g., the creation of customer value) into actual organizational actions, internally or externally.

Additionally, according to Ling and Hung (2010), in order to measure both the financial and non-financial aspects of organizational performance and to correctly gauge the influence of job satisfaction and internal-service quality on organizational performance, financial performance should be defined as the output in terms of financial accounting that can be measured by indices regarding growth and profitability. For example, a company with satisfying financial performance is expected to exceed the average in the same sector regarding the Earnings per Share (EPS) and Return on Sales (ROS) as well. As for the non-financial aspect of organizational performance, it is measured by means
of innovation-related performance, which in turn is gauged form the multiple perspectives of organizational innovation that involves both technological and managerial innovations. The technological innovation here refers to technologies required by an organization for manufacturing products or providing services, while a managerial innovation occurs in the organization’s social system and is related to the hiring/management processes and the organizational structure (Ling and Hung, 2010).

Summarizing the above, this study applied the operational definition proposed by Lee et al (2013) for the definition of organizational performance. As for the measurement dimensions of organizational performance, this study applied a combination of measurement dimensions proposed by Ling and Hung (2010) and Kaplan and Norton (1996), i.e.: (1) financial performance: using EPS as the measurement indicator; and (2) non-financial performance: i.e. customer dimension, internal process dimension, and learning and growth dimension.

Productivity

The Definition and the Dimensions of Productivity

The "conceptual definition" of "Productivity" of this study refers to the ratio between product output and input. While the dimensions of productivity of this study are drawn from the categorization of productivity factors proposed by Lin, Xu, and Chen (2004): (1) pure technical efficiency; (2) scale efficiency; (3) technical changes. Other relevant literature concerning the definition and measurement dimensions of productivity of this study is described below:

It is understood that the term productivity was first proposed by the founder of Physiocracy, F. Quesnay, in 1776. The hypothesis base, on which this term was raised, was that the resources were finite, while human desires are infinite, which is also the problem of productivity. Productivity has become quite a popular concept in recent years; however, it is also the most confusing term. The main reasons for this are that different identifications are given to its inputs and outputs, and that productivity has different representations when used in different fields (Wu, and He, 2008).

Lin, et al. (2004) studied the total factor productivity (TFP), and the changes and trends of its comprised factors (including: pure technical efficiency, scale efficiency, and technical changes) of 20 manufacturers of Taiwan's IC industry from 1996 through 2002 in their article, titled "The Effects of Taiwan's IT Industry's Internationalization on Technical Efficiency and Marginal Productivity", to verify, whether or not, investing in China poses any impact on the productivity, five major capabilities on profitability, and credit risk variables of Taiwan's IC industry.

Hou (2004) proposed that productivity refers to the ratio between output and input. If the input in question is a single-factor input, such a ratio is termed Partial Factor Productivity (PFP), and if all factor inputs are considered, such a ratio is termed Total Factor Productivity (TFP). When there are multiple factors of output and input, weights need to be weighted in a manner that allows for single statistical output index, and total input factor index; while various methods can be used to measure weights. Productivity can be used to compare the productivity performance between different manufacturers, or between different time frames of the same manufacturer. One of the objectives in measuring productivity is to understand the efficiency of company operation. Apart from the direct contribution of factor input, factors that cause changes in productivity also include: the advancement of knowledge (includes technical and management aspects), the scale of economy, changes in market structures, external economy, input quality, or changes in composition.

The above literature is the research basis of this dimension for this study.

The Effects of Accumulation of Intellectual Capital on Organizational Performance

Hung (2002) pointed out that effective capital management could significantly improve IDE performance of technology companies through the promotion of internal relationship capital. His research findings also showed that human capital is the driving factor of internal relationship capital and
organizational capital; while dynamic interactive effects are also found to be factors of intellectual capital.

Lin, Chen, and Zhou (2006) proposed that the higher the level of human capital in an enterprise, the higher the level of compensation; while the higher the level of compensation, the better the organizational performance.

Chen (2008) indicated that intellectual capital has a significant positive relationship with organizational performance.

Peng (2008) argued that, with the help of knowledge management, an organization could effectively accumulate human capital, organizational capital, and relationship capital, and thereby improve its organizational performance.

Chen, Fang, Chen, and Chien (2008) proposed that organizational culture is significantly correlated with intellectual capital, and that it also has a positive impact on organizational performance through intellectual capital.

Although the subjects of discussion of the abovementioned literature belong to various industries or scales, there are sufficient similarities that this study derives following hypotheses:

Hypothesis 1 (H1): The accumulation of intellectual capital has a significant positive effect on organizational performance.

The Effects of the Accumulation of Intellectual Capital and Productivity on Organizational Performance

Learning from the above literature review, the question of whether or not the accumulation of intellectual capital and productivity can simultaneously affect organizational performance with a multiplying effect or synergy is a very important topic, worthy of discussion. Therefore, this study deduces the third hypothesis:

Hypothesis 3 (H3): Both the accumulation of intellectual capital and productivity have a significant positive interactive effect on organizational performance.

RESEARCH METHOD

Fig. 1 illustrates how motivations, research objectives and literature review cited in the previous passages led to this study's hypotheses and conceptual research framework:
Designing the Questionnaire

The questionnaire in this study was compiled on the basis of Itemization Survey method and the aforementioned observable dimensions. On a seven-point Likert Scale, the answers were measured with 7 denoting Strongly Agree and 1 denoting Strongly Disagree. A higher score represents a greater level of agreement, and vice versa. The sample data collected was then “centralized” so the sum of scores given to all questionnaire items is zero after deducting the average. Centralization erases multicollinearity between the independent and extraneous variables, in order that their interactions are tested more accurately, as shown in the mathematical equation below:

\[ \sum (X_i - \bar{X}) = \sum Y_i = 0 \]

The questionnaire design concerning “intellectual capital” is drawn from the three sub-dimensions of intellectual capital proposed by Chen (2001), Tsen, and Hu (2010) that includes "human capital", "structure capital", and "relationship capital". The dimensional scales were used as the design base to come up with a total of 9 questions.

This study referenced the BSC system as proposed by Kaplan and Norton (1996), including "financial perspective", "customer perspective ", "internal process perspective ", and "learning and growth perspective ". The four dimensional scales were used as the design base to come up with a total of 12 questions.

This study referenced sub-dimensions proposed by Lin, et al. (2004), namely: (1) pure technical efficiency; (2) scale efficiency; and (3) technical changes; to design the questionnaire concerning "productivity". The dimensional scales were used as the design base to come up with a total of 9 questions.

Sampling Method

This study applied the Simple Random Sampling method, and targeted management staff from financial, human resources, and marketing departments of the Taiwan-listed IC design houses as
the research interview subjects. This study distributed 30 copies of questionnaire to experts as the Pilot-test, modified the questionnaire in accordance with experts’ feedback recommendations, and then performed an official Post-test with 450 copies of questionnaire distributed. There are 152 valid samples at a sample-return rate of 33.78%.

The Data Obtained from Questionnaire and Measurement Model

To validate the research structure, this study adopts Structure Equation Modeling (SEM) for Confirmatory Factor Analysis (CFA). The questionnaire measures three latent variables, i.e. intellectual capital, organizational performance and productivity. Each latent variable can be divided into observable / explicit variables, for which multiple questions are developed. The collated survey data is processed and the data file for the questionnaire responses is established. Whilst the questionnaire is designed into individual sections for the measurement system of the research model, this study performs dual measurements in order to facilitate software processing (Chen, 2010).

RESULTS AND ANALYSIS

Linear Structure Model Analysis

This study includes a CFA, an analytical method contrary to the Exploratory Factor Analysis (EFA), on the three unobservable/latent variables of intellectual capital, organizational performance and productivity. SEM is made up of structural and measurement models to efficiently tackle the cause-effect relations among implicit/latent variables. The three parts of model-testing in this study are: (1) goodness-of-fit of the measurement model; (2) goodness-of-fit of the structural model; (3) the overall model’s conformity with goodness-of-fit indicators. In other words, goodness-of-fit indicators were applied to a test of the overall goodness-of-fit effect of SEM (Diamantopoulos & Siguaw, 2000; Leea, 2012).

Analyzing Fit of the Measurement Model

To a large extent, factor loading is intended to measure the intensity of linear correlation between each latent/implicit variable and a manifest/explicit one. The closer the factor loading is to 1, the better an observable variable is in measuring latent variables. Since this study’s reliability is supported by the fact that factor loadings for all observable variables range between 0.8 and 0.9, all observable/explicit variables in the measurement model appropriately gauged the latent/implicit ones. The Average Variance Extracted (AVE), on the other hand, gauges an unobservable/implicit variable’s explanatory power of variance with regard to an observable one, with the AVE value growing in proportion to the reliability and convergent validity of that particular implicit/latent variable. As a rule, AVE must be larger than 0.5 for an observable variable’s explainable variance to exceed the measurement error (Fornell and Larcker, 1981). As Table 2 and Figure 2 show that all AVEs in this study exceed 0.5, the explicit variables have excellent reliability and convergent validity. In other words, this study has passed discriminative and convergent validity tests. As mentioned above, the questionnaires of this study do not have the issue of common method variance (CMV).

| Table 2 Judgment Indicators for the Measurement Model |
|---------------------------------|---------------------------------|-----------------|-----------------|
| Unobservable variables          | Observable Variables: Centralized Dual Measurement | Factor loading | Average Variance Extracted, AVE |
| (Implicit Variables)           | X1C                             | 0.82            | 0.65            |
| Intellectual Capital (X)        | X2C                             | 0.83            | 0.68            |
| Productivity (Mo)               | M1C                             | 0.80            | 0.63            |
|                                 | M2C                             | 0.81            | 0.64            |
The questionnaire of this study is tested and compared with CFA, which proves that it does not contain CMV. Results are shown in Table 3.

**Table 3: CMV Test Results**

<table>
<thead>
<tr>
<th>Model</th>
<th>$\chi^2$</th>
<th>DF</th>
<th>$\Delta \chi^2$</th>
<th>$\Delta$DF</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-Factor</td>
<td>1326.2</td>
<td>97</td>
<td>884.8</td>
<td>99</td>
<td>0.000</td>
</tr>
<tr>
<td>Multiple-Factor</td>
<td>441.4</td>
<td>196</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Analyzing fit of Structure Model**

Path analysis results of structure model

After the overall model of this study passed the goodness-of-fit test, the Parameter Estimates and Standard Errors (S.E.), the Critical Ratio (C.R.) among latent variables were calculated (as shown in Table 4). Additionally, Table 4 indicates: the accumulation of intellectual capital and productivity (X*Mo) have a significant interactive effect ($c=0.733$) on organizational effectiveness ($Y$); which means that when a company accumulates sufficient intellectual capital to affect organizational performance while at the same time implementing "productivity", such an action will promote the effect of achieving multiplied synergy.
### Table 4 Path Analysis Results of the Structural Model

<table>
<thead>
<tr>
<th>Path Coefficients between Implicit Variables</th>
<th>Estimate</th>
<th>S.E.</th>
<th>C.R.</th>
<th>P</th>
<th>Label</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intellectual Capital → Organizational Performance (Y)</td>
<td>.531</td>
<td>.038</td>
<td>13.974</td>
<td>***</td>
<td>a</td>
</tr>
<tr>
<td>Productivity (Mo) → Organizational Performance (Y)</td>
<td>.513</td>
<td>.034</td>
<td>15.088</td>
<td>***</td>
<td>b</td>
</tr>
<tr>
<td>X*Mo → Organizational Performance (Y)</td>
<td>.733</td>
<td>.044</td>
<td>16.590</td>
<td>***</td>
<td>c</td>
</tr>
<tr>
<td>X → X1C</td>
<td>.523</td>
<td>.041</td>
<td>12.756</td>
<td>***</td>
<td></td>
</tr>
<tr>
<td>X → X2C</td>
<td>.520</td>
<td>.033</td>
<td>15.757</td>
<td>***</td>
<td></td>
</tr>
<tr>
<td>Mo → M1C</td>
<td>.521</td>
<td>.032</td>
<td>16.281</td>
<td>***</td>
<td></td>
</tr>
<tr>
<td>Mo → M2C</td>
<td>.514</td>
<td>.031</td>
<td>16.581</td>
<td>***</td>
<td></td>
</tr>
<tr>
<td>X*Mo → X1M1C</td>
<td>.732</td>
<td>.043</td>
<td>17.023</td>
<td>***</td>
<td></td>
</tr>
<tr>
<td>X*Mo → X2M2C</td>
<td>.731</td>
<td>.042</td>
<td>17.405</td>
<td>***</td>
<td></td>
</tr>
<tr>
<td>Y → Y1C</td>
<td>.461</td>
<td>.038</td>
<td>12.132</td>
<td>***</td>
<td></td>
</tr>
<tr>
<td>Y → Y2C</td>
<td>.473</td>
<td>.037</td>
<td>12.784</td>
<td>***</td>
<td></td>
</tr>
</tbody>
</table>

Note: * indicates P<0.05; ** indicates P<0.01; *** indicates P<0.001

#### Coefficient of Determination

The so-called coefficient of determination is also known as Squared Multiple Correlation (SMC), which is the explaining level of the implicit independent variable on the implicit dependent variable. In other words, the R² value shown in Table 5 indicates that the implicit independent variable has adequate explaining ability on the implicit dependent variable respectively.
### Table 5 Path Coefficient of Determination

<table>
<thead>
<tr>
<th>Model</th>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>Std. Error of the Estimate</th>
<th>Change Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>R Square</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Change</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>F Change</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>df1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>df2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Sig. F Change</td>
</tr>
<tr>
<td>1</td>
<td>.853</td>
<td>.728</td>
<td>.716</td>
<td>.611</td>
<td>.012</td>
</tr>
<tr>
<td>2</td>
<td>.864</td>
<td>.746</td>
<td>.731</td>
<td>.382</td>
<td>.015</td>
</tr>
</tbody>
</table>

a. Predictors: (Constant), Mo and X
b. Predictors: (Constant), Mo, X and Mo*X

### Table 6 Coefficients

#### Hierarchical Regression

Table 7 was derived from Table 6:

#### Table 7 Coefficients

<table>
<thead>
<tr>
<th>Coefficients of Determination</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intellectual Capital (X), Productivity (Mo) on Organizational Performance (Y)</td>
<td>0.728</td>
</tr>
<tr>
<td>Intellectual Capital (X), Productivity (Mo) and X*Mo on Organizational Performance (Y)</td>
<td>0.746</td>
</tr>
</tbody>
</table>

#### Indices of Fit of the Overall Model

The purpose of adopting SEM in the modeling phase of this study is to explore how unobservable variables are interconnected within the structural model, to determine if the measurement model has measurement reliability, and also to measure this study’s overall goodness-of-fit effect using such indices as χ², d.f., GFI, AGFI, NFI, CFI, RMR and RMSEA. In most cases, it is required that χ²/d.f. <5, 1>GFI>0.9, 1>NFI>0.9, 1>CFI>0.9, RMR<0.05 and RMSEA<0.05 (Bagozzi & Yi, 1988). The goodness-of-fit of the overall model proved satisfactory because χ²/d.f. <5 and GFI, AGFI and NFI all exceed 0.90, with the RMR smaller than 0.05 (see Table 8).

#### Table 8 The Fitting Evaluation Table of the Overall Model

<table>
<thead>
<tr>
<th>Determination index</th>
<th>χ²</th>
<th>DF</th>
<th>GFI</th>
<th>AGFI</th>
<th>NFI</th>
<th>CFI</th>
<th>RMR</th>
<th>RMSEA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fit value</td>
<td>12.705</td>
<td>14</td>
<td>0.923</td>
<td>0.913</td>
<td>0.912</td>
<td>0.911</td>
<td>0.031</td>
<td>0.021</td>
</tr>
</tbody>
</table>
Standardized Results of SEM Analysis

The model’s overall framework was resulted from computer-aided standardization, as shown in Figure 2 (Leeb, 2011).

Path Effect Analysis & Tests on Structural Model

To test the moderating variable, this study’s author performed a hierarchical regression analysis (see Table 6), followed by centralized regression analyses and t-tests of Y versus X, Mo and X*Mo in order to examine whether the hypothesis about a significant regression coefficient c is substantiated (i.e. whether c is zero or not). The test results are shown in Table 9.
Table 9 Coefficients

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. Error</td>
<td>Beta</td>
<td></td>
</tr>
<tr>
<td>(Constant)</td>
<td>3.714</td>
<td>.772</td>
<td>.471</td>
<td>4.811</td>
</tr>
<tr>
<td>X</td>
<td>9.753</td>
<td>.813</td>
<td>.532</td>
<td>11.996</td>
</tr>
<tr>
<td>Mo</td>
<td>7.871</td>
<td>.611</td>
<td>.511</td>
<td>12.882</td>
</tr>
<tr>
<td>X*Mo</td>
<td>11.423</td>
<td>.621</td>
<td>.734</td>
<td>18.395</td>
</tr>
</tbody>
</table>

a. Dependent Variable: Organizational Effectiveness (Y)

As shown in Table 9, the Path Coefficient of Mo*X versus Y is 0.784, and the two dependent variables: accumulation of intellectual capital, and productivity, are not independent, but co-dependent. Thus, Mo*X versus Y as a moderating effect (not an interfering effect).

The following results were derived from analyses mentioned above:

(1) The accumulation of intellectual capital affects organizational performance in a significant positive manner, with a 0.532 standardized path coefficient that supports H1 (Hypothesis substantiated).

(2) The productivity affects organizational performance in a significant positive manner, with a 0.511 standardized path coefficient that supports H2 (Hypothesis substantiated).

(3) The accumulation of intellectual capital, and implementation of productivity affect organizational performance in a significant positive and interactive manner, in which the Productivity variable has a moderating effect, with a 0.734 standardized path coefficient that supports H3 (Hypothesis substantiated).

CONCLUSION AND SUGGESTIONS

Conclusions

From the afore-mentioned data analyses and results were derived this study’s conclusions, as detailed in the following passages:

(1) Regarding the verification of SEM, this study has a good model fit as its author constructed a SEM with satisfactory goodness-of-fit in the measurement, structural and the overall models.

(2) From the practical perspective:

The accumulation of intellectual capital and implementation of productivity by Taiwan-listed IC design houses affects organizational performance with a significant positive interactive effect. In other words, the "Productivity" variable of this study has a positive moderating effect. The research of Chen (2010) pointed out that, when both the Moderator and the independent variables exhibit significant interactive effects on the dependent variable, then the effect of the independent variable on the dependent variable, or the effect of the moderator on the dependent variable, has very little significance. Furthermore, when "Productivity" is showing an interfering effect, then the accumulation of intellectual capital (independent variable) and productivity (moderator) are slightly co-related (i.e. both variables have low correlation, see Figure 2).

Contributions of the Present study

(1) Innovative Applications of Research Method
Exploratory research enabled by the multi-regression analysis accounts for a majority of the existing literature, leaving the implicit variables’ moderating effect in a CFA-based research framework rarely considered. Since the present study’s main dimensions are implicit variables, CFA and SEM appear to be more suitable measurement tool and model framework respectively than multi-regression analysis. That explains why this study is relatively innovative in terms of research method.

(2) The research topic of this study is practical

Unlike the previous studies, which were largely based on EFA, this study’s author performed modeling in accordance with the summarized literature review and then verified the model for goodness-of-fit effects. The present study, consequently, is a CFA-based one addressing topics that are both important and practical in terms of business practices, with the research results not only serving as a valuable reference for further studies in relevant fields, but also for decision-makers at Taiwan-listed IC design houses seeking management insights.

Limitations and Suggestions

(1) The research of this study is limited to CFA of Taiwan-listed IC design houses. Subsequent researchers may consider exploring different industries to compare the differences in goodness-of-fit of the same model, or different models, of various industries.

(2) Regarding modeling for a CFA-based study like the present one, it is advisable that a simple verification model be built to avoid excessive complexity, and the subsequently poor goodness-of-fit (Chen, 2010). This study’s author, therefore, decided to focus solely on how the accumulation of intellectual capital affects organizational performance, with the productivity being the extraneous variable.

REFERENCES


