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The relationship between intellectual capital, firms' market value and financial performance: Empirical evidence from the ASEAN

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Abstract

Purpose – The purpose of this paper is to explore and compare the extent of intellectual capital (IC) and its four components among ASEAN countries, and examine the relationship between firms' IC, market value, and financial performance.

Design/methodology/approach – The study uses the data of 213 technology firms listed on five ASEAN stock exchanges. Pulic's Value Added Intellectual Coefficient model is modified by adding an extra component, namely, relational capital efficiency (RCE). The Kruskal-Wallis one-way ANOVA and multiple regression analysis have been utilized to test the hypotheses.

Findings – The results reveal that there is no significant difference in Modified Value Added Intellectual Coefficient (MVAIC) across five ASEAN countries; however, firms in each country tend to place a different degree of emphasis on components of MVAIC to generate corporate value. The results further indicate a positive relationship between IC and market value, confirming that firms with greater IC tend to have greater market value. Likewise, a positive relationship between IC and financial performance measures is confirmed. Specifically, IC is found to be positively associated with margin ratio and return on assets. Capital employed efficiency and human capital efficiency are found to be the most influential value drivers for both market value and financial performance while structural capital efficiency and relational capital efficiency possess less importance.

Originality/value – This study contributes to the IC literature by expanding our knowledge of IC in the emerging economies, and providing a national comparative IC research when such research is limited.

Keywords Financial performance, Intellectual capital, Market value

Paper type Research paper

Introduction

Intellectual capital (IC) literature has revealed the significance of IC to companies' financial and market performance and it has been shown increasing attention from both academics and practitioners over the last two decades. The world-wide recognition of IC and its popularity has confirmed it as an academic discipline (Serenko and Bontis, 2013). IC has been discerned as a key value driver of firms operating in the new economy and has become a most powerful factor for those companies in enhancing their competitive competence and achieving corporate success (Wang, 2008). The need for and benefit from IC for companies in knowledge intensive sectors, including high-technology and service industries is considerable; hence, they tend to invest substantially in IC. This fact makes high-technology and service sectors appropriate and attractive industries for IC research (Bontis, 2001; Hermans and Kauranen, 2005).

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In spite of its importance, IC is not easily identified, captured, and reported in financial statements. This may be partly because of the influence from accounting standards. Based on International Accounting Standard IAS 38, intangible assets, the recognition of internally generated brands, mastheads, publishing titles, and customer lists in financial statements is prohibited (IASB, 2004). It implies that the identification and measurement of these IC items in organizations is not easily accommodated by traditional accounting practice. This results in an increasing gap between firms' financial value as shown in corporate reports and stock market value (Rahman, 2012).

In response to the need for IC valuation, several methods to measure IC and its performance have been developed by various researchers, for example, Skandia IC Report Method (Edvinsson and Malone, 1997), Value Added Intellectual Coefficient (VAIC^{TM}) Model (Pulic, 1998, 2000), and Intangible Asset Monitor Approach (Sveiby, 1997). Among these methods, Pulic's VAIC^{TM} is widely adopted by academics and practitioners as a method to measure IC and reflect the market value of corporations. There has been some criticism of VAIC^{TM} and this will be enumerated below, however, irrespective of the critique, it provides a standardized and integrated measure, which allows cross-organizational or cross-national comparison and analysis (Chen *et al.*, 2014; Phusavat *et al.*, 2011; Young *et al.*, 2009; Zeghal and Maaloul, 2010). In the light of this criticism the research has modified Pulic's original VAIC^{TM} model and this will be discussed further in the literature review.

The attempt to measure the impact of IC on value creation as well as the attempt to capture relationships between IC and firms' value and performance, especially in developing countries, has been scarce (Guthrie *et al.*, 2012; Hermans and Kauranen, 2005). Within SouthEast Asia this has particular importance given the establishment of the ASEAN economic community (AEC) and regional economic integration, by 2015. AEC aims to establish a single market and production base; a highly competitive economic region; a region of equitable economic development; fully integrated into the global economy. The AEC promotes free movement of goods, services, investment, skilled labor, and free flow of capital (ASEAN, 2014b). There is evidence that natural-resource-intensive products were the main exports and imports of ASEAN countries over the past two decades; however, the focus has now changed to electronics and other relatively sophisticated manufactures (UNCTAD, 2013). This fact has emphasized the importance of IC in the ASEAN region. To achieve the expectations of those in the region, all countries in ASEAN should therefore collaborate more effectively and generate a higher competitive advantage, especially through the management of IC. However, IC performance of corporations in the ASEAN is in question, and little research has been documented (Phusavat *et al.*, 2012).

To fill this research gap, the current research was carried out in the context of selected ASEAN countries. The five largest emerging economies in ASEAN and also the founders of ASEAN, Indonesia, Malaysia, Philippines, Singapore, and Thailand, have been selected for the study due to the availability of data in the English language and the comparability of the financial structure. In response to industry appropriateness, it focusses on the high-technology sectors of these five ASEAN countries. In sum, the study aimed to explore and compare IC performance of listed companies operating in the high-technology sector across five countries in ASEAN as well as examine empirically the relationship between firms' IC, market value, and financial performance. The data were drawn from financial statements and annual reports of these firms.

Particularly, this research sets out to evaluate and compare IC efficiency – the Modified Value Added Intellectual Coefficient (MVAIC) adapted from Pulic (1998) – of

listed firms in technology industries among different ASEAN countries. Its aim is also to empirically investigate the relationship between the value creation efficiency (MVAIC) and market-to-book (MB) ratio as a proxy of firms' market value as well as firms' financial performance, particularly margin ratio, and return on assets (ROA).

This study contributes to the body of knowledge on IC in many ways. First, the research will shed light on the limited prior comparative IC research across the nations by assessing and comparing IC efficiency in the high-technology sector in selected ASEAN economies. This gives an overview of IC performance of technology firms in developing countries. Second, it will provide empirical evidence on the relationship between IC and firms' market value as well as financial performance by using data from listed companies in these countries. Thus, the findings from this study are expected to expand our understanding of IC and its impact on firms' value and performance in emerging economies. Third, the current paper has modified the Pulic VAIC^{TM} model by incorporating an additional component, namely, relational capital (RC), resulting in a more comprehensive measure of firm's IC efficiency.

Fourth, although Pulic proposed the use of his VAIC^{TM} as an aggregate measure of corporate intellectual performance, this study will employ the MVAIC model as a comprehensive measure and the four individual coefficients; namely, physical capital, human capital, structural capital, and RC. This adds greater insight into the explanatory power of these components on firms' market value. Fifth, previous studies rarely control for other influences that might affect firms' market value and financial performance. The current research inserts a number of control variables into the analysis aiming at an improved investigation of the relationship. Finally, this study is anticipated to be of interest to several stakeholders such as shareholders, institutional investors, academics, government agencies, and managers. For example, the results may assist managers in better managing and harnessing IC while investors may use IC efficiency as a means to assess firms' ability to create value through IC.

Following this introduction the remainder of the research paper is organized as follows. A literature review on IC research, Pulic's VAIC^{TM}, including critique and modification, are mentioned in the next section. Research methodology, which includes research setting, sample selection, hypotheses development, research method, and variable measurement, is then presented. Data analysis, including descriptive analysis, correlation analysis, and hypotheses testing, is explained in the following section. The conclusion and implications of the research as well as limitations and potential for future research are then discussed.

Literature review

Previous research applying Pulic's VAIC^{TM} model

Among various measurement models of IC, Pulic's VAIC^{TM} model has attracted much attention over the past two decades. Various researchers and practitioners have adopted Pulic's VAIC^{TM} model as a measure of IC. Much of the IC research has been performed in developed countries, while latterly IC research in developing countries has received increasing interest. The research, its results and implications are elaborated below.

Regarding the study of IC and its relationship with market value and firm's performance in developed economies, generally consistent empirical findings tend to be revealed. Research by Bassi and van Buren (1999) was one of the early works investigating the relationship between IC investment and financial performance. They identified a positive relationship between IC investment and financial performance

based on 500 US companies. Riahi-Belkaoui (2003), drawing from US multinational firms, reported a positive association between IC and financial performance, and suggested that companies with a higher degree of IC will demonstrate higher market value, implying that IC is a vital source of competitive advantage. Research by Wang (2008) exhibited a positive correlation between IC and market value in US electronic companies. Zeghal and Maaloul (2010) discovered a significant connection between IC and stock market performance using 300 UK companies in high-technology industries, whereas Rahman (2012) reported from 100 UK listed firms that an organization with greater IC efficiency tended to have a better financial performance.

Tan *et al.* (2007) applied Pulic's framework to 150 Singaporean listed companies in order to study the link between firm's IC and their financial performance. They observed much interest from many stakeholders, including shareholders, institutional investors, policy makers, scholars, and managers. Their findings demonstrated a positive association between IC and financial performance as well as expected future performance; however the contribution of IC to company performance differed across industries. Joshi *et al.* (2013) explored IC performance of the Australian financial sector. They observed that human capital had a high degree of influence on the value creation capability of the financial sector, however, more than half of their sample companies recorded very low levels of IC. The overall VAIC^{TM} and its components varied across subsector, particularly, the investment sector possessed a high value of VAIC^{TM} because of a higher level of human capital compared to other sub-sectors such as banks, insurance companies, and diversified financials.

Concerning emerging economies, the results were mixed. Chen *et al.* (2005) conducted an empirical examination of firm's IC and market value as well as financial performance based on a sample of Taiwanese listed companies and Pulic's VAIC^{TM}. They found a positive impact of IC on market value and financial performance, and that IC may be an indicator of future financial performance. They also observed different degrees of emphasis had been placed on the three components of value creation efficiency by investors. Using VAIC^{TM}, Goh (2005) investigated the efficiency of Malaysian banks in employing their IC. All banks tended to generate efficiency via human capital rather than structural capital and capital employed. Foreign banks were generally more highly efficient compared to domestic banks. Significant differences were identified between ranking of banks according to efficiency and traditional accounting measures. They suggested urgent attention and remedial actions were needed for 70 percent of domestic banks to enhance their efficiency.

Appuhami (2007) examined the influence of IC on investors' capital gains on shares using data drawn from the Thai banking, finance, and insurance sector. The research revealed a positive and significant association between IC and investors' capital gains. Young *et al.* (2009) compared IC performance of commercial banks in Asian economies. Controlling for the influence of loan quality, fund utilization, and the Asian financial crisis, they reported that capital employed and human capital are the two main value drivers for Asian banks. The highest IC performance can be seen with banks in Hong Kong while banks in Thailand obtained highest improvement over the period studied. Phusavat *et al.* (2011) carried out an empirical investigation of the interrelationship between IC and performance of large manufacturing firms in Thailand. IC was found to be positively and significantly related to leading manufacturing firms' performance, particularly return on equity, ROA, revenue growth, and employee productivity. Razafindrambinina and Anggreni (2011) focussed on an investigation of the link between IC and corporate financial performance of consumer goods firms listed on the

Jakarta Stock Exchange in Indonesia. The results confirmed the contribution of IC to financial performance and that the level of IC also affected future performance.

While the research mentioned above found positive relationships, some research could find little or no relationships while others found results contrary to expectations. Morariu (2014) utilized the VAIC™ model to determine IC performance of the Romanian companies, and investigate the relationship between IC performance and traditional corporate performance, which was measured via profitability, productivity, and market value. The results indicated a significant negative relationship between VAIC™ and market value, implying that firms are not generating value from their intellectual, physical and financial resources, or at least this is not recognized by the capital market in that country. None of VAIC™ components, namely, capital employed, human capital, and structural capital, explained the variation in Romanian firm's profitability. They argued that this may be because of the limited depth and maturity of the markets and the impact of the global economic crisis. Additionally, they found that capital employed efficiency (CEE) and structural capital efficiency (SCE) had no significant correlation with productivity while human capital efficiency (HCE) was found to have negative relationship with productivity. Britto *et al.* (2014) aimed to explain whether IC elements or traditional accounting measures of efficiency can better evaluate value creation by Brazilian real estate companies. They pointed out a significant inverse relationship between IC and market value that is companies with higher value demonstrated lower levels of IC, except for CEE.

Pulic's VAIC™, critique, and modification

The VAIC™ was developed and proposed by Pulic (1998, 2000) as a measurement model of a firms' IC. It offers information on value creation efficiency of both tangible and intangible assets of a firm. He argued that this method provides two important aspects of valuation and value creation not offered by other models. First, it can be applied to unlisted firms where the market-based IC value is not available. Second, it provides a monitoring system of the efficiency of business activities carried out by employees, whether their capability is pointed toward value creation or value demolition. Pulic (2000) described firms' market value as stemming from both capital employed and IC, which comprises of human capital and structural capital. Hence, he argues, the efficiency of firms is derived from three inputs – physical and financial capital, human capital, and structural capital – generating three measures namely the CEE, the HCE, and the SCE. The value of VAIC™ is the sum of these three efficiency measures. The higher overall value of VAIC™ indicates better management utilization of firms' value creation capability. The calculation of the original Pulic VAIC™ can be elaborated:

$$\begin{aligned} \text{VA} &= \text{OUT}-\text{IN} \\ \text{CEE} &= \text{VA}/\text{CE} \\ \text{HCE} &= \text{VA}/\text{HC} \\ \text{SCE} &= \text{SC}/\text{VA} \\ \text{ICE} &= \text{HCE}+\text{SCE} \\ \text{VAIC}^{\text{TM}} &= \text{ICE}+\text{CEE} \end{aligned}$$

where VA is the value added of a particular firm; OUT the total revenues; IN the total expenses excluding employee costs; CEE the capital employed efficiency; CE the capital employed both physical and financial capital, measured by total assets – intangible assets; HCE the human capital efficiency; HC the human capital, measured by total

employee expenditures; SCE the structural capital efficiency; SC the structural capital; measured by VA–HC; ICE the intellectual capital efficiency; and VAIC^{TM} the value added intellectual coefficient.

It has been shown above and is generally documented that VAIC^{TM} has been widely adopted in both academic and practical studies and that it has a number of advantages (Chen *et al.*, 2005; Firer and Williams, 2003; Goh, 2005; Tan *et al.*, 2007; Young *et al.*, 2009). First, Pulic's method is straightforward and simple to use in determining the value of IC. It permits stakeholders to examine and evaluate overall resources and their value creation efficiency. Second, the acquisition of data required in the model is feasible because all the data are obtained from corporate financial reports. Third, VAIC^{TM} is more objective and verifiable compared to other measurements because the data used in its calculation are audited (Young *et al.*, 2009). Fourth, VAIC^{TM} makes cross-organizational or cross-national comparison possible, unlike other measurement models which require both financial and non-financial measures often including some subjective judgments. These measures are naturally customized to individual organizations, and some of the measures especially non-financial measures are not always publicly available; hence, any comparative study on those models becomes complicated (Tan *et al.*, 2007). Finally, the companies can use the VAIC^{TM} model to evaluate their own IC and organizational performance exclusive of the application of industry standards (Laing *et al.*, 2010).

There are therefore some sound reasons why the VAIC^{TM} is appropriate to this analysis; however a number of authors have pointed out limitations of the model. A major paper, which systematically addresses VAIC^{TM}'s weaknesses in depth, is by Stahle *et al.* (2011). They analyzed the validity of the VAIC^{TM} by describing VAIC^{TM} via its calculation methods and discussing its theoretical "misperceptions" as well as testing the hypothesis regarding its correlation with market value in order to detect any inconsistent findings of previous studies. They assert that their analysis revealed that VAIC^{TM} designated the efficiency of the firm's labor and capital investment rather than IC. They point to a critical validity problem being its calculation formulae, which contains "perfect superimposition" between HCE and SCE. Moreover, the calculation of SC has been pointed out to be confusing the use of cash flow and capitalized entities. Furthermore, IC is claimed to be the source of added value created from intangibles, including human capital, structural capital, and RC; however, VAIC^{TM} has not included RC in its calculation. To emphasize an inconsistency with Pulic's findings, their statistical results demonstrate no relationship between market value and VAIC^{TM} or its components. They believe that the reasons behind these mixed results are the confusion in the computation of SC and a misapplication of IC concept.

This critique is somewhat in line with an earlier work by Andriessen (2004) in his evaluation of various IC models and methods. He has concerns over some of its assumptions. For example, the use of expenses, labor costs, to represent an asset (HC), a confusion over flow and stock of IC items, the absence of a defined causal relationship between, say, HC and value, the fact that "SC effect" is the inverse of "HC effect" and that value creation may actually be a result of synergy between the various components of IC, which is not reflected in the model.

The thrust of the above arguments are contained within a methodological and critical review of VAIC^{TM} undertaken by Iazzolino and Laise (2013). In this they assert that VAIC^{TM} is not a rival to other performance measures such as EVA and thus it can be usefully included as an innovative indicator of IC efficiency in multidimensional dashboards such as BSC or Skandia Navigator. Iazzolino and Laise (2013) observe that

Pulic uses re-interpreted terms compared to the Skandia Navigator and (p. 556) point to a "semantic shift," rather than "conceptual vagueness." In other words, by drawing on exclusively accounting terms and data he is not directly relating to the language of knowledge management (KM). Naturally therefore, while this VAIC™ model can be helpful given the ease of data collection, it may be unhelpful in cross-functional integration of the topic. In a wide review of models which help understand corporate value, Starovic and Marr (2003) include VAIC™ as one of the range of approaches involved in measuring, reporting, and managing IC, concluding that eventually it may be a combination of these ideas that provides the most practical solution. Thus VAIC™ is clearly not the final word in IC measurement and management.

Concerning the limitations of the VAIC™ model, some researchers have modified and extended the original model (Chang, 2007; Nazari and Herremans, 2007; Ulum *et al.*, 2014). To arrive at a more comprehensive measure, the current study has also modified VAIC™ model by adding RC as part of ICE with RC measured by marketing costs as a proxy. Thus it extends the original VAIC™ discussed above. Figure 1 displays the formation of MVAIC used in this study, while its calculation is shown below:

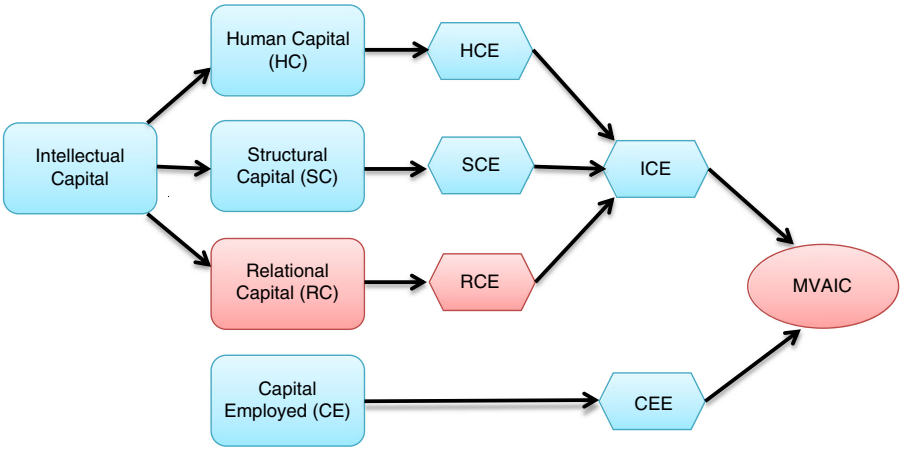
$$\begin{aligned} \text{RCE} &= \text{RC/VA} \\ \text{ICE} &= \text{HCE+SCE+RCE} \\ \text{MVAIC} &= \text{ICE+CEE} \end{aligned}$$

where RC is the marketing costs; RCE the relational capital efficiency; and MVAIC the Modified value added intellectual coefficient.

Research methodology

Research setting

The main focus of this research is IC performance in selected ASEAN countries; thus, background information of these countries and their economies are elaborated here. The Association of Southeast Asian Nations, ASEAN, was founded on August 8, 1967 in Bangkok, Thailand. The ten ASEAN member countries include five founders, which are Indonesia, Malaysia, Philippines, Singapore, and Thailand, and five newly joined members, which are Brunei Darussalam, Vietnam, Laos PDR, Myanmar, and



Source: Ulum *et al.* (2014)

Figure 1.
The formation of MVAIC

Cambodia. It aims to accelerate the economic growth, social progress, and cultural development in the region; promote regional peace and stability as well as promote active collaboration and mutual assistance on matters of common interest in the economic, social, cultural, technical, scientific, administrative, educational, professional, agricultural, trading, and industrial fields (ASEAN, 2014a). The five largest economies, which are five founders, are selected for the current study according to the availability of the data and their comparative financial structures. These ASEAN countries differ in term of population, GDP, growth rate, and unemployment rate. Table I exhibits their background information.

A majority of ASEAN countries had enjoyed high GDP growth prior to the Asian financial crisis of 1997-1998 varying between 8 and 12 percent. Most of them adopted outward-oriented strategies, indicating openness to trade and investment. These included eliminating export taxes, reducing import tariffs, initiating financial sector reforms, and launching financial market liberalization programs. Consequently, almost half of the total capital inflow to developing countries was attracted to this region (Law, 2006; Khoon and Shin, 2010; Sheera and Bishnoi, 2013). Despite its benefits of accelerating economic growth, financial openness can be viewed as harmful to developing countries. It restricts monetary policy independence, increases the volatility of interest rates and stock market volatility, as well as causing increases in economic volatility due to large and varying inflows of foreign capital (Hwang *et al.*, 2013). A majority of the countries in ASEAN suffered from the financial crisis; however, they recovered quite rapidly by strengthening the banking sector and financial system as well as developing the domestic debt market and bond market (Sheera and Bishnoi, 2013).

In 2007, ASEAN members agreed to implement the AEC, the biggest integration exercise in the developing world, by 2015. The AEC Blueprint focusses on four objectives: first, the establishment of a single market and production base (including nearly 600 million population and USD2 trillion in production); second, a highly competitive economic region; third, a region of equitable economic development; fourth, a region fully integrated into the global economy. AEC commits to the free flow of goods, services, foreign direct investment, skilled labor, and free movement of capital in the community (ASEAN, 2014b). Similar to those resulting from the European Single Market, AEC is expected to produce gains amounting to 5.3 percent of the region's income. The beneficial gains could increase to more than 11.6 percent of income, if new free trade agreements with major trade partners are developed from the regional integration as anticipated. Shortly after the AEC agreement was attained, the global financial crisis of 2008 occurred. It originated from the rise in asset prices and was due to poor monitoring by the financial institutions in the West. The world economy fell into profound and prolonged recession. Unexpectedly, some ASEAN countries'

Table I.
ASEAN selected countries – background information

	Population 2011 (million)	GDP 2011 (US$ billion)	GDP 2011 (% change)	Unemployment rate
Indonesia	240.493	834.335	6.400	6.800
Malaysia	28.731	247.565	5.200	3.200
Philippines	95.834	216.096	4.658	7.200
Singapore	5.255	266.498	5.300	2.291
Thailand	64.262	339.396	3.536	1.200

Source: IMF World Economic Outlook database

economies expanded throughout the recent global crisis, such as Indonesia, while others' economies weakened but recuperated quickly. The AEC agreement is debatably contributing to the establishment of confidence in the region's future (Petri *et al.*, 2012).

Over the past 20 years, the ASEAN's exports and imports have moved from natural-resource-intensive products to electronics and other somewhat high-tech manufactures. Agricultural sectors have continuously produced less contribution to GDP over time while sophisticated manufactures and services sectors have generated higher contribution to income growth (UNCTAD, 2013). Consequently, the management of IC is vital to their competitive advantage and corporate success; however, study of IC performance and its association with firm's market value and corporate performance is somewhat limited. Therefore, this study aims to conduct IC research in five selected ASEAN countries in order to fill the research gap.

Sample selection

Data used in the current study are drawn from listed firms operating in the "technology" sector of five stock exchanges located in the five largest ASEAN economies. Specifically, they are the Indonesia Stock Exchange (IDX), the Bursa Malaysia (BM), the Philippines Stock Exchange (PSE), the Singapore Exchange (SGX), and the Stock Exchange of Thailand (SET). The technology industry is targeted because of its potential as a knowledge intensive sector, which makes it an ideal sector for IC research (Wang, 2008; Wang and Chang, 2005). The classification of sectors in five stock exchanges varies slightly; thus, it is necessary to identify the main functions of firms in the "technology" sector in the study. The technology sector here refers to technology and communication, telecommunication, information and networking, cable and wires, and electronic equipment.

The individual stock exchanges were accessed in 2011 and the lists of companies were drawn in order to identify a sample frame. The IDX incorporated 432 companies, in which there were 20 firms operating in telecommunication, computer and services, cable, and electronics (IDX, 2011). The BM included 968 firms listed on the two markets; Main Market and ACE Market. There were 29 Technology companies in the former and there were 74 technology firms listed in the latter, resulting in 103 technology companies (BM, 2011). Within 245 firms listed on the PSE, there were 17 firms, which were operating in telecommunication and information technology sub-sectors (PSE, 2011). Among 782 companies listed on the SGX, there were 69 firms classified as telecommunication and electronics products (SGX, 2011). There were 38 technology companies from a total of 541 Thai firms listed on the SET (2011). The number of firms operating in the technology sector of individual stock exchanges is illustrated in Table II.

Stock exchanges/countries	The number of listed firms		% of sample
	All sectors	Technology	
IDX/Indonesia	432	20	8.1
BM/Malaysia	968	103	41.7
PSE/Philippines	245	17	6.9
SGX/Singapore	782	69	27.9
SET/Thailand	541	38	15.4
Total	2,968	247	100.0

Table II.
The number of technology firms in each stock exchange

After collecting the data, not all companies were usable for the research. Companies in different countries were excluded from the study due to various reasons, such as non-availability of annual reports, changes in main business, changes in financial year-end, liquidation and corporate restructuring, incomplete data, and problems in calculating variables. Excluding these companies yields a final sample size of 213 companies in total. Table III exhibits the distribution of the sample.

Hypotheses development

The research hypotheses, which are developed based on both theoretical literature and findings from prior empirical studies, are elaborated below. The previous empirical findings have called for more research on IC and firms' market value as well as performance in emerging countries. It is expected that IC in emerging economies may have different implications on firms' value creation processes and performance improvement compared to developed economies. Figure 2 demonstrates the research framework.

The current research initially aims to measure and compare IC efficiency of technology listed firms across ASEAN countries. Hence, previous IC research in selected ASEAN countries has been explored in order to learn more about IC performance of each country; however, it is observed that IC information of these countries is somewhat limited, especially the comparison of IC among ASEAN nations. For example, there was no identified IC research performed in the Philippines. Concerning Indonesia, there were a few examples of IC research. Prabowo and

Table III. Distribution of sample

Stock exchanges/countries	The number of sample	% of sample
IDX/Indonesia	12	5.6
BM/Malaysia	91	42.7
PSE/Philippines	12	5.6
SGX/Singapore	61	28.6
SET/Thailand	37	17.5
Total	213	100.0

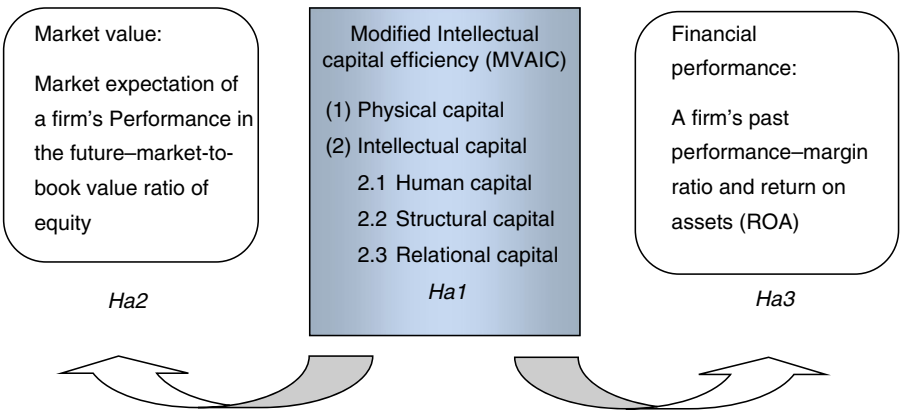


Figure 2. Research framework

Soegiono (2010) investigated the effect of a specific type of ownership, government ownership, on IC performance of Indonesian banks. They failed to detect the relationship between government ownership and IC performance; however, a positive effect of the percentage of fee-based income to total operating income on IC performance has been detected. Razafindrambinina and Anggreni (2011) studied the relationship between IC and corporate financial performance of selected listed companies in Indonesia. The results confirmed that IC does contribute to the financial performance of consumer goods firms in Indonesia with the exception of the revenue growth variable. Surprisingly, not much IC performance research has been carried out in Singaporean companies except the research by Tan *et al.* (2007), which examined the association between the IC of firms and their financial performance. A positive relationship between IC and company performance was revealed.

Concerning Malaysia, Goh (2005) adopted the efficiency coefficient VAIC^{TM} to measure the IC performance of commercial banks in Malaysia. The results demonstrated that all banks have relatively higher HCE than SCEs. Khalique *et al.* (2013) examined the role of IC as an integral element of electronics small and medium enterprises. They indicated that organizational performance has the strongest relationship with human capital, followed by spiritual capital (based on faith, emotion, religious knowledge, and ethic value), technological capital, and customer capital. Chen *et al.* (2014) investigated the effect of IC on changes in productivity of insurance firms in Malaysia. Their analysis disclosed a positive association between IC and changes in productivity.

Regarding Thailand, a few researches on IC and its effect on organizational performance have been undertaken. Using data of listed companies in the Thai stock market, Appuhami (2007) explored the effect of IC on investors' capital gains. The results indicated a significant positive association between IC and capital gain. Phusavat *et al.* (2011) empirically examined the influence of IC and its components on a manufacturing firm's industrial operations and performance. The findings revealed a positive and significant relationship between IC and firm's performance. Phusavat *et al.* (2013) further explored IC by studying the role of IC in supporting productivity measurement. The results confirmed their expectation that IC has a significant relationship with value added productivity, and that IC can be employed as a surrogate for productivity measurement. Some of the IC research conducted in the Thai language attempts to relate KM and IC and to develop a revised IC model rather than examine the relationship between IC and performance (Chaikongkiat and Sarnswang, 2008; Rerkpatanakit, 2008; Thieanphut, 2006).

From the literature review undertaken, it is observed that no research on cross-national comparison of IC performance in Asia has been conducted, apart from the studies of Young *et al.* (2009) and Phusavat *et al.* (2012). Young *et al.* (2009) explored the IC performance of commercial banks in eight Asian economies from 1996 to 2001. Their results indicated that both physical and human capitals are the main contributors to the value creation process of banks. It was found that banks in different countries performed unequally well. Particularly, banks in Hong Kong performed best from an IC perspective while those in Thailand had the highest level of improvement over the period. Phusavat *et al.* (2012) examined the interrelationships between IC and economic development, particularly GDP per capita, in five Southeast Asian countries. They found that the National Intellectual Capital Indicator (NICI) as an indicator of IC had a significant association with GDP per capita. Based on NICI scores, Indonesia, Malaysia, Philippines, and Thailand are classified as efficiency driven while Singapore is categorized as innovation driven. In sum, IC efficiencies of ASEAN countries tend to

be different. Thus, there is a need for further cross-national IC research in ASEAN countries in order to gain more insightful information on IC performance of these countries. The first hypothesis is posited below:

Ha1. Firms' ICE is different across ASEAN countries.

The assessment and comparison of IC performance is also extended to the four components of IC as shown in the following hypotheses:

Ha1.1 Firms' physical capital efficiency is different across ASEAN countries.

Ha1.2 Firms' HCE is different across ASEAN countries.

Ha1.3 Firms' SCE is different across ASEAN countries.

Ha1.4 Firms' RCE is different across ASEAN countries.

After evaluating IC performance among the ASEAN countries, the current study further aims to investigate the relationship between IC and firms' market value as well as financial performance. Theoretically, the increasing difference between firms' market and book values results from the inability of traditional financial statements to totally capture the benefit of investment in IC. Riahi-Belkaoui (2003) stated that in an efficient market, organizations with a higher degree of IC will display higher market values. It implies that IC is an important resource in generating competitive advantage; hence, it should contribute to firms' performance. Some authors examined the relationship between IC and companies' market value. However, their findings were mixed. Firer and Williams (2003) conducted research on the relationship between IC and firms' profitability based on 75 publicly traded companies in South Africa; however strong association was not revealed. Likewise, Rahman (2012) empirically examined the role of IC in determining market value by taking 100 UK firms listed on the London Stock Exchange; however, no strong relationship between IC and stock market performance was found.

In contrast, Chen *et al.* (2005) used the data drawn from Taiwanese listed firms to investigate the relationship between IC and firms' market value. Their findings supported the hypothesis that IC positively influences firms' market value. Appuhami (2007) investigated IC of 33 listed firms in the banking sector, in Thailand, and found that firms' IC has a significant impact on investors' capital gain on shares. Wang (2008) documented a positive relationship between IC and market value of the US electronic companies. Zeghal and Maaloul (2010) analyzed the role of value added as an indicator of IC and its effect on the stock market performance using 300 UK companies. They found a significant association between IC and stock market performance in high-technology industries. According to findings from previous studies, the second hypothesis is proposed as follows:

Ha2. Firms with greater ICE tend to have higher market value.

The study also expands to capture the association between the four components of IC and firms' market value. Four hypotheses are further presented as:

Ha2.1 Firms with greater physical capital efficiency tend to have higher market value.

Ha2.2 Firms with greater HCE tend to have higher market value.

Ha2.3 Firms with greater SCE tend to have higher market value.

Ha2.4 Firms with greater RCE tend to have higher market value.

Additionally, the relationship between IC and firms' financial performance is explored in previous research, and again the results are mixed. Using the evidence from the companies listed on the Hong Kong Stock Exchange, Chan (2009) failed to reveal support for a relationship between IC and four measures of financial performance. Only a moderate link between IC and the profitability measures was detected. Bassi and Van Buren (1999) found a positive association between IC investment and financial performance from the investigation of 500 US firms. Riahi-Belkaoui (2003) reported the evidence of a positive relationship between IC and financial performance drawing from 81 US multinational firms. Chen *et al.* (2005) documented a positive influence of IC on firms' financial performance using Taiwanese listed firms. Wang and Chang (2005) studied the influence of IC on nine performance measures in a cause-and-effect model. They found that most of the IC elements have direct effects on business performance except human capital, which has an indirect effect on firms' performance via other elements.

Tan *et al.* (2007) used 150 Singaporean listed companies to investigate the relationship between IC and financial returns of companies. Their results showed positive relationships between IC and current and future company performance. Zeghal and Maaloul (2010) reported a positive impact of IC on economic and financial performance based on 300 UK firms. Razafindrambinina and Anggreni (2011) investigated the relationship between IC and corporate financial performance of listed companies in Indonesia. They revealed that IC is related to financial performance, except for revenue growth. Drawing from manufacturing firms listed on the SET 100, Phusavat *et al.* (2011) detected a significantly positive relationship between IC and firms' performance as well as a high correlation between human capital and employee productivity. Their further research also identified IC as a surrogate measurement for productivity (Phusavat *et al.*, 2013). Rahman (2012) used 100 UK listed firms to confirm that greater IC efficiency leads to better financial performance. Drawing from these previous findings, the third hypothesis is posited as follows:

Ha3. Firms with greater ICE tend to have higher financial performance.

Similarly, the relationship between IC and financial performance is extended into four components of IC. The following hypotheses indicate the proposed relationships:

Ha3.1 Firms with greater physical capital efficiency tend to have higher financial performance.

Ha3.2 Firms with greater HCE tend to have higher financial performance.

Ha3.3 Firms with greater SCE tend to have higher financial performance.

Ha3.4 Firms with greater RCE tend to have higher financial performance.

Research method

Annual reports and financial statements of sample firms for the year 2011 were gathered through stock exchanges' and companies' web sites. In the case of non-availability of annual reports on both web sites, electronic mail and telephone calls were made requesting information from the firms during 2012. Market information, particularly closing stock prices of sample firms were retrieved from the stock exchanges. Multivariate analysis, particularly the Kruskal-Wallis One-Way ANOVA by ranks and multiple regression, are applied to test the hypotheses. The former was used to compare IC efficiency across ASEAN countries while the latter was employed to investigate the association between IC efficiency and firms' market value and financial performance.

Variable measurement

This section presents the definition and measurement of all variables included in the analysis. These are dependent variables, independent variables, and control variables. Although the data from firms' annual reports and their market information were initially recorded in their local currencies, all variables were converted to the US dollars in order to accommodate the comparative research.

Dependent variables. Dependent variables used in the regression models comprise of firms' market value and financial performance, which are described below:

(1) Market value. Market value indicates the overall values of shares issued by the firm. Market value determines the amount an individual must pay to acquire the entire firm at a certain period. MB value ratio of equity, an index of market expectation of a firm's future performance compared to book value, is used as a proxy of market value of IC in this study: MB of common stock = market value/book value where market value is the number of shares outstanding *x* share price at year-end; book value the book value of shareholders' equity – paid-in capital of preferred stocks.

(2) Financial performance. Financial performance: drawn from accounting information represents past performance. Two traditional performance measures are used in the study, including margin ratio and ROA. The calculation of these two financial performance indicators is displayed as follows:

- Margin ratio, a measure of profitability from sales, demonstrates the ability of firms to generate net profit from total sales: Margin ratio = net profit/total net sales.
- ROA is the capability of firms in asset utilization regardless of firms' financing policy. It is widely used in several IC studies as a proxy for financial performance:

$$\text{ROA} = \text{operating income/average total assets.}$$

Independent variables. The study modified Pulic's VAIC^{TM} by adding an extra component based on the work of Ulum *et al.* (2014). MVAIC and its four components – CEE, HCE, SCE, and RCE – are used as independent variables in the regression models. The calculation of MVAIC is summarized as follows:

$$\begin{aligned} \text{VA} &= \text{OUT–IN} \\ \text{CEE} &= \text{VA/CE} \\ \text{HCE} &= \text{VA/HC} \\ \text{SCE} &= \text{SC/VA} \\ \text{RCE} &= \text{RC/VA} \\ \text{ICE} &= \text{HCE+SCE+RCE} \\ \text{MVAIC} &= \text{ICE+CEE} \end{aligned}$$

where VA is the value added of a particular firm; OUT the total revenues; IN the total expenses excluding employee costs; CEE the capital employed efficiency; CE the capital employed both physical and financial capital, measured by total assets – intangible assets; HCE the human capital efficiency; HC the human capital, measured by total employee expenditures; SCE the structural capital efficiency; SC the structural capital, measured by VA–HC; RC the relational capital, measured by marketing expenses; RCE the relational capital efficiency; ICE the intellectual capital efficiency; and MVAIC the modified value added intellectual coefficient.

Control variables. Prior studies in this area rarely include control variables into the analysis. To properly test the associations between IC efficiency and firms' market value as well as financial performance, a number of control variables are included into the regression models of this study.

(1) Firms' size (SIZE)Larger firms possess more resources, which include knowledge resources, than smaller firms. Hence, larger firms may generate higher MB value ratio and greater financial performance. To control this effect, firms' size variable is measured as the natural logarithm of total assets at year-end and inserted into the equations:

$$\text{SIZE} = \text{natural logarithm of total assets at year-end.}$$

(2) Inflation rate (INF)Market information and financial performance are primarily captured in local currencies; thus, there is a need to control for the cross-country variation in exchange and inflation rates:

$$\text{INF} = \text{inflation rate.}$$

(3) Firms' age (AGE)The age of sample population of firms may have an influence on the emphasis of difference IC components. Companies age may have an influence on the profile of IC, that is say, between HC and SC; more established companies may have had greater time to convert HC to SC, for example:

$$\text{AGE} = \text{the age of sample companies.}$$

Empirical results

Descriptive analysis

Information on descriptive statistics, including the number of cases, minimum, maximum, mean, and standard deviation, of all variables is provided in Table IV.

Panel A in Table IV summarizes the descriptive analysis of dependent variables, which relate to firms' market value and financial performance. MB value ratio has the

Variables	*n*	Minimum	Maximum	Mean	SD
Panel A: dependent variables					
MB	213	0.00	6,493.25	39.5597	453.08620
Margin	213	−8.35	0.95	−0.0821	0.75740
ROA	213	−2.03	3.68	0.0172	0.32713
Panel B: independent variables					
CEE	213	−0.96	13.06	0.2314	0.91817
HCE	213	−11.38	119.77	1.9423	8.73226
SCE	213	−10.81	12.05	0.4212	1.91200
RCE	213	−4.58	5.68	0.1393	0.63876
MVAIC	213	−10.61	133.83	2.7341	9.75473
Panel C: control variables					
SIZE	213	6.00	10.51	7.7416	0.80300
INF	213	0.5000	8.4000	3.9268	2.36402
AGE	213	2	184	23.4695	21.74000

Table IV.
Descriptive statistics

mean score of 39.5597 indicating that average market value of technology firms is about 39 times higher than their book value. The high standard deviation of MB indicates significant variations of market price comparing to book value among companies. Margin ratio and ROA presents relatively low mean scores of −0.0821 and 0.0172, respectively, implying that technology firms were generally facing a difficulty in making profit during 2011.

Panel B in Table IV presents the descriptive analysis of independent variables, which are MVAIC and its four components; the CEE, the HCE, the SCE, and the RCE. The mean score of MVAIC is 2.7341, revealing that technology firms in this study created USD 2.7341 for every USD 1.00 utilized in 2011. The HCE is the most influential component in creating wealth with the greatest mean value of 1.9423, compared to CEE, SCE, and RCE with the mean scores of 0.2314, 0.4212, and 0.1393, respectively. This is consistent with previous findings that human capital is the most effective driver of value creation compared to structural capital, and physical and financial capital (Rahman, 2012; Zeghal and Maaloul, 2010).

The HCE, the SCE, and the RCE relate to the value created by money spent on employees, on structural capital, and on relational networks, which are the intangible assets; hence their emphasis is on IC and intangible components. On the other hand, the CEE is the value generated by one unit of physical and financial capital; thus, it is the tangible component. The combined mean score of the HCE, the SCE, and the RCE is 2.5028, which is much higher than the mean CEE of 0.2314. The comparison suggests that firms create value substantially more efficiently from IC and intangible components rather than from physical and financial component. It is in line with prior literature that companies operating in the new economy tend to create value via IC rather than physical capital (Pulic, 2004; Rahman, 2012; Zeghal, 2000; Zeghal and Maaloul, 2010).

Panel C in Table IV reveals the descriptive analysis of the control variables, which are size, inflation rate, and age. Firms' size is measured as the natural logarithm of total assets at year-end; hence, the mean value of firms' size of 7.7416 is difficult to interpret. The standard deviation of total assets is high, indicating that there are significant variations in size among firms. Inflation rate has a mean score of 3.9268, exhibiting the middle level of inflation in these ASEAN countries. Last, the mean score of firms' age is 23.4695 years with high standard deviation, representing high variations in firms' age among the sample companies.

Financial performance and IC efficiency may differ across countries; therefore, it is appropriate to examine variables by countries. Table V illustrates descriptive statistics for individual countries. Technology firms in Philippines and Malaysia have high-market value with MB of 109.2940 and 72.7754, respectively, while the other three countries have much lower market value. Particularly, the MB of companies operating in Singapore, Thailand, and Indonesia are 6.3166, 2.3675, and 1.6013, respectively. The Indonesian sample have profitability ratios positive (margin and ROA), indicating that technology firms in Indonesia tended to generate profit while the rest of the sample have profitability ratios negative, implying that many technology firms in Malaysia, Philippines, Singapore, and Thailand do not record a profit in their annual accounts for the year in question.

Regarding ICE, it is suggested that, on average, technology firms in Singapore have the highest MVAIC of 4.3736 while those in Philippines and those in Indonesia are the second and the third highest MVAIC of 4.3189 and 3.5789, respectively. Technology firms in Thailand and Malaysia possess relatively lower MVAIC of 2.4046 and 1.4487.

Table V. Descriptive statistics for individual countries

Variables	Indonesia ($n = 12$) Mean	SD	Malaysia ($n = 91$) Mean	SD	Philippines ($n = 12$) Mean	SD	Singapore ($n = 61$) Mean	SD	Thailand ($n = 37$) Mean	SD
MB	1.6013	1.3019	72.7754	680.5279	109.2940	368.5079	6.3166	29.3276	2.3675	2.3082
Margin	0.0559	0.0640	−0.0518	0.3927	−0.6384	1.5995	−0.1081	1.1119	0.0218	0.1574
ROA	0.0594	0.0469	−0.0090	0.1585	−0.1567	0.6065	0.0944	0.4878	−0.0027	0.1867
CEE	0.1297	0.0768	0.1944	0.2594	−0.0194	0.3294	0.4190	1.6658	0.1276	0.1955
HCE	2.7717	2.0165	0.9182	2.0822	3.3032	9.9612	3.2947	15.2034	1.5207	3.8238
SCE	0.4560	0.3318	0.2777	2.3964	1.0338	0.7149	0.3624	1.1076	0.6609	2.1668
RCE	0.2214	0.17060	0.0584	0.39188	0.0014	0.08390	0.2975	0.083059	0.0954	0.88792
MVAIC	3.5789	2.42056	1.4487	2.99221	4.3189	9.96866	4.3736	16.91972	2.4046	4.33255
SIZE	8.2952	1.0532	7.2607	0.5447	7.6916	1.0749	8.0609	0.6853	8.2345	0.6861
INF	8.4000	0.0000	5.5000	0.0000	4.1000	0.0000	0.5000	0.0000	4.2000	0.0000
AGE	30.8333	10.47797	15.9341	9.99422	29.0833	26.44534	31.6721	33.28399	24.2703	12.37526

All technology companies in the study tended to create value from intangible components, which are human capital, structural capital, and RC rather than financial and physical capital. Human capital seems to be the most beneficial component in generating value for firms in most countries.

Correlation analysis

The direction and magnitude of relationships among all variables were examined by conducting correlation analysis in order to gain more insight before testing the hypotheses. To accommodate non-normality of the data, Spearman's correlation coefficient, which is a non-parametric statistical test, was applied. Table VI represents a correlation matrix from Spearman's correlation coefficient analysis.

It is found that the correlation coefficients indicate significant positive associations between most pairs of variables. As expected, MVAIC has significant positive correlations with firm's financial performance, but unexpectedly not with firm's market value. It implies that firms with greater ICE have higher financial performance, but not higher market value. Specifically, MVAIC is significantly and positively related to margin ($r = 0.760$, $p < 0.01$) and ROA ($r = 0.739$, $p < 0.01$), indicating strong relationships between value efficiency and financial performance. The results, therefore, strongly support *Ha3*, but do not support *Ha2*. Regarding the four components of MVAIC, CEE, and HCE are significantly associated with financial performance, but not with market value while SCE and RCE are significantly related to both firms' market value and financial performance measures; however, the correlation coefficients are small, indicating weak relationship among them. Additionally, RCE unexpectedly has a negative relationship with firm's market value. Consequently, the results strongly support *Ha2.3*, *Ha3.1*, *Ha3.2*, *Ha3.3*, and *Ha3.4* while rejecting *Ha2.1*, *Ha2.2*, and *Ha2.4*. These findings are in line with prior studies of Zeghal and Maaloul (2010) and Rahman (2012).

It is noted that MVAIC has significant positive relationships with its four components. Particularly, MVAIC has the strongest association with human capital ($r = 0.854$, $p < 0.01$), followed by its relationship with structural capital, physical capital, and RC with correlation coefficients of 0.502 ($p < 0.01$), 0.337 ($p < 0.01$), and 0.157 ($p < 0.05$), respectively. Margin and ROA are found to be significantly associated between each other with strong correlation of 0.918 ($p < 0.01$). This result is expected as one performance measure increases, the other measure is likely to increase. The results further demonstrate that firms' market value has relatively low, but significant association with one of the financial performance measures, particularly, ROA ($r = 0.119$, $p < 0.01$), supporting the statement that financial performance is the lead indicator of firms' market value. The finding is consistent with the previous research of Rahman (2012).

In order to gain a preliminary view of relationships proposed in *Ha1*, which focusses on firms' ICE and its components across different ASEAN countries, Spearman's correlation coefficient was performed on selected variables, mainly dependent and independent variables, for each country. Table VII illustrates a correlation matrix from Spearman's correlation coefficient analysis for individual countries.

In general, correlation coefficients exhibit moderate to strong positive relationships between most pairs of variables across countries. MVAIC is expectedly found to be significantly and positively associated with financial performance measures in five countries; however, its relationship with firms' market value has been detected with the Thai sample only. The relationships between value efficiency and firms'

Table VI. Correlation matrix: spearman correlation coefficient

Variables	MB	Margin	ROA	CEE	HCE	SCE	RCE	MVAIC	SIZE	INF	AGE
MB	1.000	0.079	0.119**	0.108	0.054	0.310**	−0.203**	0.118	−0.127	0.122	−0.011
Margin		1.000	0.918**	0.622**	0.878**	0.200**	0.181**	0.760**	0.247**	−0.042	0.045
ROA			1.000	0.708**	0.875**	0.185**	0.209**	0.739**	0.305**	−0.054	0.138*
CEE				1.000	0.479**	−0.247**	0.146*	0.337**	−0.003	0.015	0.044
HCE					1.000	0.274**	0.274**	0.854**	0.351**	−0.030	0.097
SCE						1.000	−0.433**	0.502**	0.089	−0.059	0.030
RCE							1.000	0.157*	0.283**	−0.139*	0.159*
MVAIC								1.000	0.308**	−0.060	0.062
SIZE									1.000	−0.365**	0.449**
INF										1.000	−0.249**
AGE											1.000

Notes: *,**Correlation is significant at 0.05 and 0.01 level, respectively (two-tailed)

Variables	CEE	HCE	SCE	RCE	MVAIC
Indonesia (n = 12)					
MB	0.587*	0.224	0.224	−0.028	0.224
Margin	0.497	0.510	0.510	0.266	0.510
ROA	0.629*	0.594*	0.594*	0.168	0.594*
Malaysia (n = 91)					
MB	0.072	−0.128	0.098	−0.169	0.012
Margin	0.595**	0.945**	0.299**	0.220*	0.800**
ROA	0.654**	0.922**	0.261*	0.251*	0.748**
Philippines (n = 12)					
MB	0.175	−0.049	0.077	0.046	−0.035
Margin	0.811**	0.979**	−0.490	0.564	0.979**
ROA	0.895**	0.944**	−0.524*	0.620*	0.944**
Singapore (n = 61)					
MB	0.404**	0.105	0.183	−0.113	0.076
Margin	0.578**	0.808**	0.285*	0.022	0.748**
ROA	0.780**	0.758**	0.225	−0.031	0.636**
Thailand (n = 37)					
MB	0.096	0.344*	0.668**	−0.243	0.448**
Margin	0.786**	0.815**	0.034	0.150	0.638**
ROA	0.866**	0.908**	0.092	0.172	0.757**

Notes: *,**Correlation is significant at 0.05 and 0.01 level, respectively (two-tailed)

Table VII.
Correlation matrix for individual countries: Spearman correlation coefficient

market value as well as financial performance are investigated by countries as follows. For the Indonesian sample, MVAIC has strongly positive relationships with ROA ($r = 0.594$, $p < 0.05$) while its relationships with firms' market value and margin are not significant. Similar associations are identified between three components of MVAIC, namely, CEE, HCE, and SCE, and the performance measure ROA. Unfortunately, RCE has no significant correlation with both financial performance and market value. CEE is the only component among four that is found to be correlated significantly with firms' market value ($r = 0.587$, $p < 0.05$).

In the case of the Malaysian sample, the two financial performance measures (margin and ROA) are found to be associated positively with MVAIC ($p < 0.01$). Their strong relationships are detected with correlation coefficients of 0.800 and 0.748, respectively. Nevertheless, no significant correlation has been found between firms' market value and MVAIC as well as its components. Relatively strong relationships of financial performance measures are significantly perceived with CEE and HCE while only relatively low relationships of financial performance measures are revealed with SCE and RCE.

Regarding Philippines, MVAIC has significant positive correlations with the two financial performance measures; margin and ROA. Specifically, strong relationships between MVAIC, and margin and ROA are detected by correlation coefficients of 0.979 and 0.944 ($p < 0.01$), respectively. No relationship between MVAIC and firms' market value has been identified. In line with the relationships of MVAIC and financial performance measures as well as firms' market value, its two components; CEE and HCE, demonstrate positive strong relationships with margin and ROA with correlation coefficients above 0.800 ($p < 0.01$). RCE also demonstrates positive relationship with ROA ($r = 0.620$, $p < 0.05$), but not with MB and Margin. Unexpectedly, there are

significantly negative associations appeared between SCE and ROA. Even though it is unexpected, it is not entirely surprising as there is consistency here with the findings of Zeghal and Maaloul (2010) and Rahman (2012).

For the Singaporean sample, there are positive strong relationships between MVAIC and the two financial performance measures (margin and ROA) with correlation coefficients of 0.748 and 0.636 ($p < 0.01$), respectively. However, no relationship between MVAIC and firms' market value is detected. The CEE component has positive strong associations with all financial performance measures and the firms' market value ($p < 0.01$); the HCE component obtains positive strong relationships with margin and ROA ($p < 0.01$), but obtains no relationship with firms' market value; SCE is found to be positively correlated with the only one financial performance measure; margin ($r = 0.285$, $p < 0.05$); RCE has no significant relationship with all financial performance measures and market value.

The Thai sample reveals that MVAIC possesses a positive strong relationship with both financial performance measures and firms' market value with correlation coefficients above 0.400 ($p < 0.01$). In line with MVAIC, the HCE component is found to be significantly associated with both financial performance measures with correlation coefficients above 0.800 ($p < 0.01$) and firms' market value ($r = 0.344$, $p < 0.05$). However, the CEE component has positive relationships with all financial performance measures with correlation coefficients above 0.750 ($p < 0.01$), but not with firms' market value while the SCE component obtains a positive relationship with firms' market value ($r = 0.668$, $p < 0.01$), but not with any of financial performance measures. Lastly, no significant relationship has been discovered in the relation to RCE.

In sum, it is noted that relationships between MVAIC and financial performance measures as well as firms' market value vary slightly across countries. Most countries reveal positive relationships between MVAIC and financial performance measures, but not firms' market value. Thailand is the only country that exhibits association between MVAIC and firms' market value. In most countries, RCE is recognized as a component that has less significant relationships with financial performance measures.

Hypotheses testing

As discussed earlier, there are three main hypotheses developed based on previous research. The first hypothesis is concerned with ICE and its four components across countries. The second hypothesis is to investigate the relationships between ICE as well as its four components and firms' market value. The last hypothesis is to examine the relationships between ICE as well as its four components and financial performance. The non-parametric Kruskal-Wallis one-way ANOVA test is applied to test the first hypothesis whereas linear multiple regression analysis is employed to test the others. Each hypothesis testing is elaborated as follows.

Hypothesis 1

To test the first set of hypotheses, the non-parametric Kruskal-Wallis one-way ANOVA test[1] is used in order to accommodate non-normality of the data and unequal group sizes. The Kruskal-Wallis test provides K-W statistics, which indicate whether significant differences among groups exist. Particularly, significant K-W statistics imply that at least one of the groups is significantly different from at least one of the others. However, no information, on which groups and how many groups are different, is provided. In other words, the Kruskal-Wallis test does not provide pairwise comparison, which is the comparison between each pair of these groups. To determine which pairs of groups are

significantly different, the critical differences for all pairs were calculated and compared to absolute actual differences (Siegel and Castellan, 1988).

Therefore, the non-parametric Kruskal-Wallis one-way ANOVA test is performed by the statistical software package, and then pairwise comparisons are manually undertaken for significant K-W statistics. Country is served as the grouping variables, resulting in five groups; Indonesia, Malaysia, Philippines, Singapore, and Thailand. The mean rank of ICE and its four components are then computed and compared. Table VIII demonstrates the result from Kruskal-Wallis test.

The result in Table VIII reveals that there are significant differences among countries in relation to the four components of MVAIC; CEE, HCE, SCE, and RCE, but not MVAIC itself. The findings indicate that technology firms across countries employ physical capital, human capital, structural capital, and RC in order to create value to different extents; however, there is no evidence supporting the overall difference in MVAIC across different countries in the chosen sector.

Concerning CEE, there is a significant difference among technology firms in different countries with K-W statistics of 12.848 ($p < 0.05$). Pairwise comparison reveals that the differences are between Philippines and Malaysia ($p < 0.05$), and between the Philippines and Singapore ($p < 0.10$). Based on the mean rank, technology firms in the Philippines obtain a significant lower mean rank (63.42) compared to those in Malaysia (116.75) and Singapore (114.39). It is implied that firms in Philippines tend to generate lower value from financial and physical capital compared to those in Malaysia and Singapore. Regarding HCE, a significant difference among high-technology firms in various countries is identified with K-W statistics of 10.227 ($p < 0.05$). Pairwise comparison further points out that the difference is found between Indonesia and Malaysia ($p < 0.05$). Specifically, Indonesian companies obtain higher mean rank (153.00) compared to Malaysian firms (96.96). The findings indicate that Indonesian firms tend to generate higher value from human capital compared to Malaysian firms.

For SCE, the K-W statistics of 12.016 ($p < 0.05$) denote that there is a significant difference among firms in different countries. Pairwise comparison provides the evidence that the differences occur between Philippines and Malaysia ($p < 0.05$), and between the Philippines and Singapore ($p < 0.10$). According to the mean rank, technology firms in the Philippines represent a substantially higher mean rank (160.00) compared to those in Malaysia (97.38) and Singapore (105.85). That is, companies in the Philippines tend to generate value from structural capital significantly higher than those in Malaysia and Singapore. With regard to RCE, K-W statistics of 27.505 ($p < 0.01$) highlight a significant difference among companies in different countries. Pairwise comparison emphasizes significant differences between Malaysia and three other countries, including Indonesia, Singapore, and Thailand. Similarly, it reveals significant differences between Philippines and three other countries, namely, Indonesia, Singapore, and Thailand. In detail, Malaysia and Philippines possess relatively low mean rank of 87.62 and 69.42, respectively, compared to Indonesia (150.67), Singapore (124.15), and Thailand (124.43). The result implies that firms in Malaysia and Philippines may create lower value from RC compared to those in the other three countries.

From the statistics, it is argued that firms in Indonesia produce substantially more value from human capital and RC; those in Malaysia generate value predominantly from financial and physical capital; those in Philippines create value mainly from structural capital; those in Singapore produce value mostly from financial and physical capital as well as RC; those in Thailand tend to create value largely from RC. The findings imply that firms in Indonesia may place a high emphasis on human capital.

	Indonesia ($n = 12$)	Malaysia ($n = 91$)	Philippines ($n = 12$)	Singapore ($n = 61$)	Thailand ($n = 37$)	K-W statistics (df = 4)
1. The capital employed efficiency (CEE)						
Mean Rank	84.92	116.75	63.42	114.39	92.14	12.848**
Pairwise comparison						
Indonesia		31.83	21.15	29.47	7.22	
		(48.76)	(64.82)	(50.14)	(52.74)	
Malaysia			53.33**	2.36	24.61	
			(53.13)	(26.27)	(30.96)	
Philippines				50.97*	28.72	
				(50.14)	(52.74)	
Singapore					22.25	
					(33.08)	
2. The Human Capital Efficiency (HCE)						
Mean Rank	153.00	96.96	101.25	114.90	105.62	10.227**
Pairwise comparison						
Indonesia		56.04**	51.75	38.10	47.38	
		(53.13)	(64.82)	(50.14)	(52.74)	
Malaysia			4.29	17.94	8.66	
			(48.76)	(26.27)	(30.96)	
Philippines				13.65	4.37	
				(50.14)	(52.74)	
Singapore					9.28	
					(33.08)	
3. The Structural Capital Efficiency (SCE)						
Mean rank	123.00	97.38	160.00	105.85	110.16	12.016**
Pairwise comparison						
Indonesia		25.62	37.00	17.15	12.84	
		(48.76)	(64.82)	(50.14)	(52.74)	
Malaysia			62.62***	8.47	12.78	
			(62.46)	(26.27)	(30.96)	
Philippines				54.15*	49.84	
				(50.14)	(52.74)	
Singapore					4.31	
					(33.08)	
4. The Relational Capital Efficiency (RCE)						
Mean rank	150.67	87.62	69.42	124.15	124.43	27.505***
Pairwise comparison						
Indonesia		63.05***	81.25**	26.52	26.24	
		(62.46)	(70.63)	(50.14)	(52.74)	
Malaysia			18.20 (48.76)	36.53***	36.81**	
				(33.66)	(33.73)	
Philippines				54.73**	55.01*	
				(54.63)	(52.74)	
Singapore					0.28	
					(33.08)	
5. Modified Value Added Intellectual Coefficiency (MVAIC)						
Mean rank	142.50	96.66	102.83	116.74	106.22	8.127

Notes: Values in cells of pairwise comparisons are actual absolute differences while the values in parenthesis are critical differences. *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$

Table VIII. Result of Kruskal-Wallis one-way ANOVA

They may invest in employee training programs or employee stock option programs (ESOP) to enhance employee capability, attitude, and satisfaction. Firms in the Philippines may create value by focussing on structural capital. They may establish and sustain their organizational culture, strengthen their management control system, enhance their information technology, and invest in patents, copyrights, and trademarks. Concerning RC, firms in Indonesia, Singapore, and Thailand may develop good relationships with suppliers and customers. This may be done through the implementation of supplier and customer selection programs. The findings also reveal that Malaysian and Singaporean firms gain greater benefit from financial and physical capital (CEE), more than firms in other ASEAN countries.

In summary, there is no significant difference among countries regarding MVAIC. The results reject *Ha1*, indicating that firms' ICE is not different across countries. However, differences are found between Indonesia, Malaysia, Philippines, and Singapore in relation to the four components of MVAIC; CEE, HCE, SCE, and RCE. The results therefore support *Ha1.1*, *Ha1.2*, *Ha1.3*, and *Ha1.4*, indicating that firms' physical capital efficiency, HCE, SCE, and RCE are different across countries.

Hypothesis 2 and 3

Multiple regression analysis is used to test these two sets of hypotheses. Market value is used as a dependent variable in the second hypothesis while two traditional financial performance measures, which are margin and ROA, are used as dependent variables in the third hypothesis. ICE and its four components are employed as independent variables in both hypotheses. Three control variables, which are firms' size, inflation rate, and firms' age are also included in the analysis according to their potential effects on firms' market value and financial performance. In each hypothesis, there are two multiple regression models specified. The first model investigates the association between a dependent variable and MVAIC while the second model tests the proposed relationship between a dependent variable and IC's components. The multiple regression models are displayed as follows:

H2:

Model 1:

$$\mathrm{MB} = \alpha_0 + \alpha_1 \times \mathrm{MVAIC} + \alpha_2 \times \mathrm{SIZE} + \alpha_3 \times \mathrm{INF} + \alpha_4 \times \mathrm{AGE} + \varepsilon$$

Model 2:

$$\mathrm{MB} = \alpha_0 + \alpha_1 \times \mathrm{CEE} + \alpha_2 \times \mathrm{HCE} + \alpha_3 \times \mathrm{SCE} + \alpha_4 \times \mathrm{RCE} + \alpha_5 \times \mathrm{SIZE} + \alpha_6 \times \mathrm{INF} + \alpha_7 \times \mathrm{AGE} + \varepsilon$$

H3:

Model 1:

$$\mathrm{Performance}_n = \alpha_0 + \alpha_1 \times \mathrm{MVAIC} + \alpha_2 \times \mathrm{SIZE} + \alpha_3 \times \mathrm{INF} + \alpha_4 \times \mathrm{AGE} + \varepsilon$$

Model 2:

$$\mathrm{Performance}_n = \alpha_0 + \alpha_1 \times \mathrm{CEE} + \alpha_2 \times \mathrm{HCE} + \alpha_3 \times \mathrm{SCE} + \alpha_4 \times \mathrm{RCE} + \alpha_5 \times \mathrm{SIZE} + \alpha_6 \times \mathrm{INF} + \alpha_7 \times \mathrm{AGE} + \varepsilon$$

Table IX illustrates results of the multiple regression analysis. The interpretation of the regression result for *H2* model 1 is as follows. The overall model fit can be assessed

Independent variables	*H2* Dependent variable: MB *B*	*t*-value	*H3* Dependent variable: margin *B*	*t*-value	Dependent variable: ROA *B*	*t*-value
Model 1						
Intercept	5.177	4.117***	−2.756	−5.683***	−0.200	−2.076**
MVAIC	0.453	37.606***	0.024	4.673***	0.026	28.912***
SIZE	−0.624	−3.890***	0.320	5.185***	0.024	1.978**
INF	0.033	0.639	0.036	1.618	−0.003	−0.842
AGE	0.008	1.268	0.000	−0.166	0.000	−0.909
Adjusted R^2	0.876		0.183		0.804	
F-value	362.599***		12.694***		213.492***	
Model 2						
Intercept	3.623	3.107**	−1.396	−2.997***	−0.423	−6.358***
CEE	2.121	5.133***	0.092	4.900***	0.248	13.948***
HCE	0.292	6.513***	0.028	6.257**	0.006	3.077***
SCE	0.124	2.072**	0.003	0.323	−0.003	−0.932
RCE	−0.169	−0.933	0.104	1.321	0.017	1.610
SIZE	−0.414	−2.803**	0.135	2.239**	0.049	5.843***
INF	0.048	1.021	0.034	1.732*	0.002	0.809
AGE	0.007	1.377	0.003	1.303	−0.000	−0.239
Adjusted R^2	0.902		0.361		0.912	
F-value	267.787***		17.881***		306.863***	

Notes: *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$

Table IX. Results of multiple regression analysis

through the adjusted coefficient of determination (R^2) and *F*-statistical test. The adjusted R^2 is 0.876, indicating that 87.6 percent of the possible variation in the firms' market value is explained by the model 1. The regression model 1 is found to be statistically significant with an *F*-statistical test of 362.599 ($p < 0.01$), suggesting that the amount of variation explained by the regression model is superior to the base line prediction. MVAIC is found to have a significantly positive relationship with firms' market value with correlation coefficient of 0.453 and the *t*-value of 37.606 ($p < 0.01$). It is implied that if the firms generate MVAIC for one more unit, then their MB value ratio is expected to be increased by 0.453 units. The finding supports *Ha2*, confirming that firms with greater ICE tend to have higher market value.

The regression output for *H2* model 2 reveals the overall model fit with the adjusted R^2 of 0.902 and *F*-statistical test of 267.787 ($p < 0.01$). That is, the regression model 2 is able to explain about 90.2 percent of the variance in the firms' market value. Three components of MVAIC, which are CEE, HCE, and SCE, are found to be positively correlated with firms' MB value ratio. Their correlation coefficients are 2.121 ($t = 5.133$; $p < 0.01$), 0.292 ($t = 6.513$; $p < 0.01$), and 0.124 ($t = 2.072$; $p < 0.05$), respectively. From the magnitude of the *t*-statistics, HCE has the greater significant contribution to the model, compared to CEE and SCE. The findings imply that every additional CEE generated is associated with an extra of 2.121 in MB; every added unit of HCE is related to an increase of 0.292 in MB; every increased unit of SCE is linked to a raise of 0.124 in MB. Unexpectedly, RCE has no significant relationship with MB. The findings significantly support *Ha2.1*, *Ha2.2*, and *Ha2.3*, but not *Ha2.4*, concluding that firms with greater physical capital efficiency, HCE, and SCE, but not RCE, tend to have higher market value.

This confirms that IC is a vital resource that drives market performance of technology firms. It is indicated that investors in ASEAN countries discern IC as a key factor of the value creation process, in technology firms. The findings therefore support the statement that enterprises with a higher degree of IC will present a higher market performance. The empirical evidence also shows a positive relationship between firms' market value and three components of MVAIC; particularly CEE, HCE, and SCE, implying that investors appreciate the contribution of financial and physical capitals, human capital, and structural capital in the value generation process, reflecting in rising stock market value. It is consistent with the previous findings of Riahi-Belkaoui (2003) Chen *et al.* (2005), Appuhami (2007), and Wang (2008).

Regarding *H3* with margin as a dependent variable, model 1 exhibits the adjusted R^2 of 0.183 with the *F*-statistical test of 12.694 ($p < 0.01$). It is revealed that the regression model 1 explains about 18.3 percent of the variation of the margin ratio. It is found that MVAIC is significantly associated with margin; however, the relationship is weak with the correlation coefficient of 0.024 and the *t*-value of 4.673 ($p < 0.01$). The findings imply that as firms generate MVAIC by one unit, margin ratio increases by 0.024. In other words, firms with greater ICE tend to have higher margin ratio. Hence, *Ha3* is supported.

The overall fit of the regression model 2 for margin is examined via an adjusted R^2 of 0.361 and its *F*-statistical test of 17.881 ($p < 0.01$). It is indicated that 36.1 percent of the possible variation in the margin ratio is explained by the model 2, which is found to be statistically significant. Two components of ICE, CEE, and HCE, are found to be positively associated with firms' margin ratio with the correlation coefficients of 0.092 ($t = 4.900$; $p < 0.01$) and 0.028 ($t = 6.257$; $p < 0.05$), respectively. The findings imply that as CEE increases by one unit, margin ratio increases by 0.092 units. Similarly, as HCE increases by one unit, margin ratio increases by 0.028 units. Unexpectedly, SCE and RCE are not statistically significant with the margin ratio. The findings support *Ha3.1* and *Ha3.2*, but not *Ha3.3* and *Ha3.4*, confirming that firms with greater physical capital efficiency and HCE, but not with SCE, and RCE, tend to have higher margin ratio.

Concerning *H3* with ROA as a dependent variable, the adjusted R^2 of 0.804 with *F*-statistical test of 213.492 ($p < 0.01$) indicate that multiple regression model 1 is capable of explaining about 80.4 percent of the variation in the firms' ROA. The output discloses that MVAIC is significantly and positively related to ROA with correlation coefficient of 0.026 and the *t*-statistic of 28.912 ($p < 0.01$). It is implied that if the firms create MVAIC for one more unit, then their ROA is anticipated to be increased by 0.026 units. The findings support *Ha3*, confirming that firms with greater ICE tend to have higher financial performance, particularly ROA.

The regression model 2 for ROA points out that about 91.2 percent of the variation in the firms' ROA is explained by multiple regression model 2 with the adjusted R^2 of 0.912 and *F*-statistical test of 306.863 ($p < 0.01$). Regarding MVAIC components, it is found that two components, CEE and HCE, are positively associated with firms' ROA with the correlation coefficients of 0.248 ($t = 13.948$; $p < 0.01$) and 0.006 ($t = 3.077$; $p < 0.10$), respectively. Concerning the *t*-statistics, CEE has significantly higher contribution to the regression model compared to HCE. Correlation coefficients of two predictors imply that if the firms generate CEE for one more unit, their ROA is expected to be increased by 0.248 units; if the firms create HCE for one additional unit, firms' ROA is anticipated to be increased by 0.006 units. It is noticed that there is no significant relationship between ROA and the other two components of

MVAIC, namely, SCE and RCE. Consequently, the findings confirm that firms, with greater physical capital efficiency and HCE, but not SCE and RCE, tend to generate higher ROA. The *Ha3.1* and *Ha3.2*, but not *Ha3.3* and *Ha3.4*, are supported by these results.

These results are broadly in line with previous research findings (Chen *et al.*, 2005; Firer and Williams, 2003; Rahman, 2012; Shiu, 2006; Ting and Lean, 2009; Zeghal and Maaloul, 2010; Zhang *et al.*, 2006) confirming that companies with a greater degree of IC will exhibit higher profitability. Regarding the four components of MVAIC, CEE, and HCE are found to be the most influential value drivers according to their relationship to the dependent variables, MB, margin, and ROA. It implies that financial and physical capital still retains an important role in generating firms' profitability and market performance. It is consistent with the research findings of Zeghal and Maaloul (2010) and Razafindrambinina and Anggreni (2011) that capital employed has a long tradition in the value creation process, and it maintains a significant role in improving firms' performance for stakeholders in ASEAN. Additionally, the findings imply that human capital has received high attention from ASEAN firms as an effective source of wealth creation. Its importance may derive from the fact that human capital is vested in employees rather than firms (Edvinsson, 1997); hence during the recent world economic downturn it may reflect the pressure on companies' turnover and efforts to downsize (Rahman, 2012). SCE and RCE seem to be the least influential value drivers among MVAIC components.

Discussion and conclusion

IC is increasingly receiving attention as a value creator of firms and in order to generate competitive advantage in business, especially for those operating in knowledge-based industries. The current study provides empirical results exploring the level of IC among different ASEAN countries as well as examining the association between IC and both financial and market performance, in the technology sector. It is found that the proportion of total IC is not significantly different across countries. However, different IC components have contributed to total IC in different proportions that is the profile of IC differs across countries. The research further reveals a significant effect of IC on both firms' market value and selected financial performance measures. Specifically, a positive relationship between IC and firms' market value, and that between IC and two traditional financial performance measures, margin, and ROA, have been identified. CEE and HCE are found to be the most influential value drivers while SCE and RCE have no statistically significant positive relationship with financial performance. In establishing these relationships, firm size appears to be a significant control variable in most regression models; inflation rate and firm's age are found to possess less significant control influence.

The current study has some limitations which should be acknowledged. First, the sample firms are drawn from five stock exchanges in five ASEAN countries, therefore, the research is restricted to the ASEAN technology companies listed on these five stock exchanges and should be extrapolated beyond these with care. More Asian countries should be included in the analysis in order to increase the sample size and gain greater reliability of the results; however, the unavailability of annual reports and financial statements in the English language is a major restriction in this. The current research is cross-sectional in nature; hence, the interpretation of the results is limited to the research period of one-year, however in the future a database consisting of multiple years may add further insights.

The computation of MVAIC is based on the accounting information deriving from financial statements. This, together with cross-national nature of this study, means the findings may be influenced by differences in accounting practices and stock exchange regulations across the different countries, though every effort was made to interpret information in an appropriate and consistent manner. The research has modified the original VAIC model, which has featured in a number of previous studies, however some academic papers, including Stahle *et al.* (2011), have questioned the validity and appropriateness of VAIC and this has been discussed in the literature review above. Finally, the unexpected findings and non-significant results may be derived from the context of emerging economies, where the understanding of IC and its concept may not be fully developed, compared to that of advanced economies. Regarding cost and benefit, for example, the ASEAN companies may not invest substantially in costs of gathering, managing, and analyzing IC; consequently, the benefit in obtaining this information cannot be realized.

Several practical implications of the research results are identified in the context of the ASEAN community. It is maintained that the current research findings should increase ASEAN firms' recognition of IC utilization in enhancing their financial performance as well as their market values. This is especially so when, over the last decade the focus has been shifted from agriculture to innovative manufacture in this region. With the commencement of AEC in 2015, ASEAN managers are encouraged to gain a better understanding of IC and put greater effort on its management. They should be aware of the contribution of each IC component in generating total IC and performance in their particular business. Concerning financial and physical capitals, firms in Philippines, are observed to have low investment in physical assets. Regarding human capital, firms in Malaysia, with low-HCE, may be required to revise their employee policy and enhance employee capability, attitude and satisfaction through training programs and ESOP. For structural capital, Malaysian firms with low-SCE should establish and maintain a positive organizational culture, develop the right management control systems and a strong IT system to support internal business processes. Moreover, they may attempt to invest in the intangible assets, such as patents, copyrights, and trademarks in order to gain competitive advantage via proprietary products or services. With respect to relational capital, firms in Philippines with relatively low level of relational networks may require to enhance the relationships with valuable partners, including international partners, for instance, suppliers and customers.

Apart from the managers, ASEAN accountants may need to place greater emphasis on the impact of IC on firm's performance in order to improve the focus, measurement, and internal reporting on IC. Investors, who are interested in the fortunes of firms operating in ASEAN countries, may need to develop their insight and concern about the importance of IC to assist them in selecting companies in their portfolio by assessing the value creation ability and IC of various firms. Finally, in making macro decisions on industrial support and grants, government agencies in ASEAN countries may utilize the concept of IC as criteria in comparing firms' value among different industries and different sectors.

There are various opportunities for further research, for example, most IC research has been conducted during a single point in time and attempted to capture IC by using several models based on positivist theory; hence, a longitudinal study that embraces field experience using interpretive theory could provide deeper and richer understanding of IC and its effect on firms' performance throughout a longer period

(Guthrie *et al.*, 2012). Related to this, the influence of IC on firms' performance may take time to be realized; thus, studies exploring the effect of IC on lagged performance may be required perhaps employing econometric modeling techniques. Future studies should extend the literature into other potential industries, such as the service sector or other knowledge-based industries. Apart from profitability other aspects of financial and non-financial performance should be considered, for instance, liquidity, productivity, and asset efficiency; though this may require some internally orientated data to be revealed by companies.

Some of its limitations have been mentioned above and hence Pulic's VAIC™ framework is still a developing concept in measuring IC; therefore, further research is encouraged in order to evaluate, develop, and modify the model to arrive at a better measurement of IC and its efficiency. This may extend to the generation and use of some other measurement models for future research against which VAIC may be validated. Finally, additional control factors, such as national GDP, cultural values, and legal and corporate governance systems, should be identified and incorporated into subsequent analysis in order to obtain even more robust findings.

Note

1. In the computation of the Kruskal-Wallis test, each of the observations is replaced by ranks. That is, all observations from all groups are ranked in a single series. The smallest score is replaced by rank 1, the next smallest score is replaced by rank 2, and the largest score is replaced by rank n (the total number of observations in all groups). The average rank for each group is calculated by dividing the sum of the ranks in each group by the total number of observations in each group. The Kruskal-Wallis test assesses the differences among the average ranks to determine whether the groups are significantly different or not (Siegel and Castellan, 1988, p. 207).

References

Andriesson, D. (2004), *Making Sense of Intellectual Capital: Designing a Method for the Valuation of Intangibles*, Elsevier Butterworth-Heinemann, Burlington, MA.

Appuhami, B.A.R. (2007), "The impact of intellectual capital on investors' capital gain on shares: an empirical investigation in Thai banking, finance & insurance sector", *Journal of Internet Banking and Commerce*, Vol. 12 No. 1, pp. 1-14.

ASEAN (2014a), "About ASEAN: overview", available at: www.asean.org/asean/about-asean/overview/ (accessed June 4, 2014).

ASEAN (2014b), "ASEAN economic community", available at: www.asean.org/communities/asean-economic-community/ (accessed June 11, 2014).

Bassi, L.J. and Van Buren, M.E. (1999), "Valuing investments in intellectual capital", *International Journal of Technology Management*, Vol. 18 No. 5, pp. 414-432.

BM (2011), "Listed companies", available at: www.bursamalaysia.com/market/listed-companies/ (accessed November 10, 2011).

Bontis, N. (2001), "Assessing knowledge assets: a review of the models used to measure intellectual capital", *International Journal of Management Review*, Vol. 3 No. 1, pp. 41-60.

Britto, D.P., Monetti, E. and Lima, J.D.R. Jr (2014), "Intellectual capital in tangible intensive firms: the case of Brazilian real estate companies", *Journal of Intellectual Capital*, Vol. 15 No. 2, pp. 333-348.

Chaikongkiat, P. and Sarnswang, S. (2008), "A causal relationship model among intellectual capital management, knowledge management and organizational effectiveness of nursing colleges under the ministry of public health", *Kasetsart Journal (Soc. Sci.)*, Vol. 29 No. 2, pp. 140-153 (in Thai).

Chang, S.L. (2007), *Valuing Intellectual Capital and Firms' Performance: Modifying Value Added Intellectual Coefficient (VAICTM) in Taiwan IT Industry*, Doctoral of Business Administration, Golden Gate University, San Francisco, CA.

Chan, K.H. (2009), "Impact of intellectual capital on organizational performance: an empirical study of companies in the hang seng index (part 2)", *The Learning Organization*, Vol. 16 No. 1, pp. 22-39.

Chen, F.C., Liu, Z.J. and Kweh, Q.L. (2014), "Intellectual capital and productivity of Malaysian general insurers", *Economic Modeling*, Vol. 36, January, pp. 413-420.

Chen, M.C., Cheng, S.J. and Hwang, Y. (2005), "An empirical investigation of the relationship between intellectual capital and firms' market value and financial performance", *Journal of Intellectual Capital*, Vol. 6 No. 2, pp. 159-176.

Edvinsson, L. (1997), "Developing intellectual capital in Scandia", *Long Range Planning*, Vol. 30 No. 3, pp. 320-331.

Edvinsson, L. and Malone, M. (1997), *Intellectual Capital: Realizing Your Company's True Value by Finding Its Hidden Brainpower*, HarperCollins, New York, NY.

Firer, S. and Williams, S.M. (2003), "Intellectual capital and traditional measures of corporate performance", *Journal of Intellectual Capital*, Vol. 4 No. 3, pp. 348-360.

Goh, P.C. (2005), "Intellectual capital performance of commercial banks in Malaysia", *Journal of Intellectual Capital*, Vol. 6 No. 3, pp. 385-396.

Guthrie, J., Ricceri, F. and Dumay, J. (2012), "Reflections and projections: a decade of intellectual capital accounting research", *The British Accounting Review*, Vol. 44 No. 2, pp. 68-82.

Hermans, R. and Kauranen, I. (2005), "Value creation potential of intellectual capital in biotechnology – empirical evidence from Finland", *R&D Management*, Vol. 35 No. 2, pp. 171-185.

Hwang, K.-M., Park, D. and Shin, K. (2013), "Capital market openness and output volatility", *Pacific Economic Review*, Vol. 18 No. 3, pp. 403-430.

IASB (2004), *Intangible Assets IAS 38*, International Accounting Standards Board, London.

Iazzolino, G. and Laise, D. (2013), "Value added intellectual coefficient (VAIC): a methodological and critical review", *Journal of Intellectual Capital*, Vol. 14 No. 4, pp. 547-563.

IDX (2011), "Listed companies", available at: www.idx.co.id/en-us/home/listedcompanies/companyprofile.aspx (accessed November 16, 2011).

Joshi, M., Cahill, D. and Sidhu, J. (2013), "Intellectual capital and financial performance: an evaluation of the Australian financial sector", *Journal of Intellectual Capital*, Vol. 14 No. 2, pp. 264-285.

Khalique, M., Isa, A.H.M. and Shaari, J.A.N.B. (2013), "Predicting the impact of intellectual capital management on the performance of SMEs in electronics industry in Kuching, Sarawak", *The IUP Journal of Knowledge Management*, Vol. XI No. 4, pp. 53-61.

Khoon, G.S. and Shin, K.S. (2010), "Empirical evidence on capital mobility in four ASEAN countries", *The IUP Journal of Financial Economics*, Vol. 8 No. 3, pp. 38-48.

Laing, G., Dunn, J. and Hughes-Lucas, S. (2010), "Applying the VAIC^{TM} model to Australian hotels", *Journal of Intellectual Capital*, Vol. 11 No. 3, pp. 269-283.

Law, S.H. (2006), "Has stock market volatility in the Kuala Lumpur stock exchange returned to pre-Asian financial crisis level?", *ASEAN Economic Bulletin*, Vol. 23 No. 2, pp. 212-229.

Morariu, C.M. (2014), "Intellectual capital performance in the case of Romanian public companies", *Journal of Intellectual Capital*, Vol. 15 No. 3, pp. 392-410.

Nazari, J.A. and Herremans, I.M. (2007), "Extended VAIC model: measuring intellectual capital components", *Journal of Intellectual Capital*, Vol. 8 No. 4, pp. 595-609.

Petri, P.A., Plummer, M.G. and Zhai, F. (2012), "ASEAN economic community: a general equilibrium analysis", *Asian Economic Journal*, Vol. 26 No. 2, pp. 93-118.

Phusavat, K., Comepa, N., Sitko-Lutek, A. and Ooi, K.B. (2011), "Interrelationships between intellectual capital and performance: empirical examination", *Industrial Management & Data Systems*, Vol. 111 No. 6, pp. 810-829.

Phusavat, K., Comepa, N., Sitko-Lutek, A. and Ooi, K.B. (2012), "Intellectual capital: national implications for industrial competitiveness", *Industrial Management & Data Systems*, Vol. 112 No. 6, pp. 866-890.

Phusavat, K., Comepa, N., Sitko-Lutek, A. and Ooi, K.B. (2013), "Productivity management: integrating the intellectual capital", *Industrial Management & Data Systems*, Vol. 113 No. 6, pp. 840-855.

Prabowo, R. and Soegiono, L. (2010), "Intellectual capital performance and government ownership: an analysis of Indonesian banks", paper presented at the International Conference on Intellectual Capital, Knowledge Management & Organizational Learning, The Hong Kong Polytechnic University, Hong Kong, November 11-12.

PSE (2011), "Listed companies", available at: www.pse.com.ph/stockMarket/listedCompany Directory.html/ (accessed November 21, 2011).

Pulic, A. (1998), "Measuring the performance of intellectual potential in knowledge economy", available at: www.vaic-on.net/ (accessed November 27, 2011).

Pulic, A. (2000), "MVA and VAICTM analysis of randomly selected companies from FTSE 250", available at: www.vaic-on.net/ (accessed November 27, 2011).

Pulic, A. (2004), "Intellectual capital: does it create or destroy value? Measuring intangible assets: state of the art", *Journal of Business Performance*, Vol. 8 No. 1, pp. 62-68.

Rahman, S. (2012), "The role of intellectual capital in determining differences between stock market and financial performance", *International Research Journal of Finance and Economics*, No. 89, April, pp. 46-77.

Razafindrambinina, D. and Anggreni, T. (2011), "Intellectual capital and corporate financial performance of selected listed companies in Indonesia", *Malaysian Journal of Economic Studies*, Vol. 48 No. 1, pp. 61-77.

Rerkpatanakit, W. (2008), *Knowledge Management of Listed Companies on the Stock Exchange of Thailand: Procedures Towards Intellectual Capital Development*, Doctor of Philosophy, Ramkhamhaeng University, Bangkok (in Thai).

Riahi-Belkaoui, A. (2003), "Intellectual capital and firm performance of US multinational firms: a study of the resource-based and stakeholder views", *Journal of Intellectual Capital*, Vol. 4 No. 2, pp. 215-226.

Serenko, A. and Bontis, N. (2013), "Investigating the current state and impact of the intellectual capital academic discipline", *Journal of Intellectual Capital*, Vol. 14 No. 4, pp. 476-500.

SET (2011), "Listed companies", available at: www.set.or.th/en/sitemap/for_listed_company.html/ (accessed November 1, 2011).

SGX (2011), "Listed companies", available at: www.sgx.com/wps/portal/sgxweb/home/company_disclosure/catalodge/company/ (accessed November 4, 2011).

Sheera, V.P. and Bishnoi, A. (2013), "Financial deepening of selected ASEAN nations", *Malaysian Journal of Economic Studies*, Vol. 50 No. 1, pp. 79-100.

Shiu, H.J. (2006), "The application of the value added intellectual coefficient to measure corporate performance: evidence from technological firms", *International Journal of Management*, Vol. 23 No. 2, pp. 356-365.

Siegel, S. and Castellan, N.J. (1988), *Nonparametric Statistics for the Behavioral Sciences*, 2nd ed., McGraw-Hill Book Company, London.

Stahle, P., Stahle, S. and Aho, S. (2011), "Value added intellectual coefficient (VAIC): a critical analysis", *Journal of Intellectual Capital*, Vol. 12 No. 4, pp. 531-551.

Starovic, D. and Marr, B. (2003), *Understanding Corporate Value: Managing and Reporting Intellectual Capital*, CIMA group, Cranfield University School of Management, Cranfield, Bedford.

Sveiby, K.E. (1997), *The New Organizational Wealth: Managing and Measuring Knowledge-Based Assets*, Berret-Koehler, New York, NY.

Tan, H.P., Plowman, D. and Hancock, P. (2007), "Intellectual capital and financial returns of companies", *Journal of Intellectual Capital*, Vol. 8 No. 1, pp. 76-95.

Thieanphut, D. (2006), *A Strategic Intellectual Capital Model for Thai Enterprises: A Study of Construction Accessories Company*, Doctor of Philosophy, Suan Dusit Rajabhat University, Bangkok (in Thai).

Ting, I.W.K. and Lean, H.H. (2009), "Intellectual capital performance in financial institutions in Malaysia", *Journal of Intellectual Capital*, Vol. 10 No. 4, pp. 588-599.

Ulum, I., Ghozali, I. and Purwanto, A. (2014), "Intellectual capital performance of Indonesian banking sector: a modified VAIC (M-VAIC) perspective", *Asian Journal of Finance & Accounting*, Vol. 6 No. 2, pp. 103-123.

UNCTAD (2013), "International mechandise trade statistics", available at: http://comtrade.un.org/pb/ (accessed January 7, 2015).

Wang, J.C. (2008), "Investigating market value and intellectual capital for S&P 500", *Journal of Intellectual Capital*, Vol. 9 No. 4, pp. 546-563.

Wang, W.Y. and Chang, C. (2005), "Intellectual capital and performance in causal models: evidence from the information technology industry in Taiwan", *Journal of Intellectual Capital*, Vol. 6 No. 2, pp. 222-236.

Young, C.S., Su, H.Y., Fang, S.C. and Fang, S.R. (2009), "Cross-country comparison of intellectual capital performance of commercial banks in Asian economics", *The Service Industries Journal*, Vol. 29 No. 11, pp. 1565-1579.

Zeghal, D. (2000), "New assets for the economy", *FMI Journal*, Vol. 11 No. 2, pp. 35-40.

Zeghal, D. and Maaloul, A. (2010), "Analyzing value added as an indicator of intellectual capital and its consequences on company performance", *Journal of Intellectual Capital*, Vol. 11 No. 1, pp. 39-60.

Zhang, J., Zhu, N. and Kong, Y. (2006), "Study on intellectual capital and enterprise's performance: empirical evidence on the Chinese securities market", *Journal of Accounting and Auditing*, Vol. 2 No. 1, pp. 10-17.

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2. Gianpaolo Iazzolino Department of Mechanical, Energy and Management Engineering (DIMEG), University of Calabri, Rende, Italy Domenico Laise Department of Computer, Control and Management Engineering, University of Rome "La Sapienza", Rome, Italy . 2016. Value creation and sustainability in knowledge-based strategies. *Journal of Intellectual Capital* **17**:3, 457-470. [Abstract] [Full Text] [PDF]
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4. Stephen Korutaro Nkundabanyanga Department of Accounting, Makerere University Business School, Kampala, Uganda . 2016. Board governance, intellectual capital and firm performance. *Journal of Economic and Administrative Sciences* **32**:1, 20-45. [Abstract] [Full Text] [PDF]