RESEARCH ARTICLE

A Measurement Model of Intellectual Capital in Thailand during the Transition Period to Knowledge-based Economy

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(Received: May 7, 2023; Revised: September 19, 2023; Accepted: October 26, 2023)

Abstract

The research aimed to propose the measurement model of intellectual capital (IC) in Thai firms listed in the Stock Exchange of Thailand (SET), where its government had been planning to become the knowledge-based economy and IC was an important feature to drive the transformation. The questionnaire was developed based on previous research, mainly Bontis (1998), and 370 Thai listed companies responded. The PLS-SEM approach was employed to derive the IC indicators, which were categorized into three parts: Human Capital (HC), Structural Capital (SC), and Relation Capital (RC). The results showed no concern of the reliability and validity of the

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IC measurement model. The result revealed that HC was likely to be reflected through individual's creativity and learning skill to solve problems and their hard-working. SC seemed to be indicated by operating procedures and accessibility of information system. The third component, RC, tended to be signified by only customer relations. The model potentially guided management to be aware of the activities which could strengthen IC in a firm. It also directed the regulators to introduce the policy encouraging Thai companies to engage with those activities.

Keywords: Intellectual Capital, Human Capital, Structural Capital, Relation Capital, Stock Exchange of Thailand

บทความวิจัย

โมเดลการวัดทุนทางปัญญาในประเทศไทยระหว่างช่วงการเปลี่ยนแปลงสู่ระบบเศรษฐกิจฐานความรู้

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บทคัดย่อ

ในปัจจุบันนี้รัฐบาลไทยได้วางแผนที่จะเปลี่ยนแปลงระบบเศรษฐกิจในประเทศไทยให้เป็นเศรษฐกิจฐานความรู้ และทุนทางปัญญาเป็นปัจจัยที่สำคัญที่จะทำให้เกิดระบบเศรษฐกิจดังกล่าว งานวิจัยนี้มีวัตถุประสงค์เพื่อศึกษาและเสนอโมเดลตัววัดสำหรับทุนทางปัญญาในบริษัทที่จดทะเบียนในตลาดหลักทรัพย์แห่งประเทศไทย โดยพัฒนาแบบสอบถามจากงานวิจัยของ Bontis (1998) และมีกลุ่มตัวอย่างจำนวน 370 บริษัทที่ได้ตอบแบบสอบถามนี้ และงานวิจัยได้ใช้วิธีสถิติ PLS-SEM ในการวิเคราะห์ข้อมูลเพื่อพัฒนาโมเดล ซึ่งประกอบด้วยทุนมนุษย์ ทุนโครงสร้าง และทุนความสัมพันธ์ ผลการวิจัยสนับสนุนความเที่ยงและความตรงของโมเดล และตัววัดทุนมนุษย์สะท้อนผ่านความคิดสร้างสรรค์ของบุคลากร ทักษะการเรียนรู้ในการแก้ไขปัญหา และการทำงานอย่างเต็มที่ ในขณะที่ทุนโครงสร้างจะแสดงผ่านกระบวนการปฏิบัติงานและการเข้าถึงระบบข้อมูล ส่วนทุนความสัมพันธ์จะสะท้อนผ่านความสัมพันธ์กับลูกค้าเป็นตัวหลัก ผลการวิจัยนี้จะทำให้ผู้บริหารเห็นแนวทางกิจกรรมในการ

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พัฒนาทุนทางปัญญาในองค์กร นอกจากนี้ หน่วยงานกำกับดูแลสามารถเสนอแนะแนวทางของนโยบายเพื่อสนับสนุนให้บริษัทต่าง ๆ พัฒนาทุนทางปัญญาในองค์กรได้

คำสำคัญ: ทุนทางปัญญา ทุนมนุษย์ ทุนโครงสร้าง ทุนความสัมพันธ์ ตลาดหลักทรัพย์แห่งประเทศไทย

Introduction

Intellectual Capital (IC) has referred to as the accumulation of all knowledge, information, intellectual property, and competencies that increase a firm efficiency embedded in individuals, business processes, and networks (Novas, Alves, & Sousa, 2017). It is an intangible asset that will enhance various aspects of firm's performance. Its importance has led to numerous studies of IC with different objectives. Many researchers (Huang & Huang, 2020; Kianto, Sáenz, & Aramburu, 2017; Lee & Lin, 2019; Rehman, Bresciani, Ashfaq, & Alam, 2021; Wang, Wang, Cao, & Ye, 2016) focused on the benefits of IC to an organization; while several researchers (Novas et al., 2017; Seleim & Khalil, 2011; Tayles, Pike, & Sofian, 2007) investigated how IC was developed in an organization. Meanwhile, many studies (Chen, Zhao, & Wang, 2015; Ferreira, Fernandes, & Veiga, 2021; Kannan & Aulber, 2004; Kianto, Ritala, Vanhala, & Hussinki, 2020; Loyarte et al., 2018) were concerned with IC measurement—how to measure it and to what extent IC existed in an organization.

The latter group had been done more than three decades and its development had been reviewed systematically and continuously (e.g. Kannan & Aulber, 2004; Pike & Roos, 2007; Kianto et al., 2020; Ferreira et al., 2021) in order to structure the ideal conceptual framework for IC measurement. These studies derived different IC measurement models. Kianto et al. (2020) suggested that IC measures need to be tailored to fit specific individual contexts. Therefore, when ones would like to detect the existence of IC in a

particular environment, they need to structure their own IC measurement model.

In Thailand, it is in the transition era for adjusting industries and the largely agricultural economy to become the knowledge-based economy. The Thai government launched the national plan covering 2017-2036 aiming to reform economic stability, human capital, competitiveness and effective governance among Thai organizations. Since 2017, the transformation has been evidently reflected through the Global Innovation Index (GII) scored by the World Intellectual Property Organization (WIPO). Thailand had moved from No. 51 among 132 economies in 2017 to No. 43 in 2018 until 2022 (WIPO, 2019; 2022). Also, several campaigns have continuingly been conducted. The clear example is the classification of the companies to be the S-curve and new S-curve industries (e.g. food for the future, robotics and biofuels and biochemicals). Thus, among Thai companies, IC has been expected to be increasingly created.

However, as far as this research was concerned, only Nimtrakoon (2015) investigated IC among Thai listed companies but she investigated in five ASEAN countries, including Thailand and this work had been done before 2017 and had measured IC using financial/non-financial data. There has been no research suggesting the IC measurement model developed from PLS-SEM approach for Thai listed companies in order to assess IC during this period.

Therefore, this current research aimed to structure the measurement model of IC in the Thai context in order to detect what indicators reliably signify the IC. This research also focused on

CEO/CFO as its participants; whereas previous researchers (e.g. Novas et al., 2017; Kittikunchotiwut & Siriyota, 2021) focused more on managers and/or employees.

The research potentially guided the regulators to identify what indicators are required to strengthen the components of IC; consequently, set up the policies to stimulate Thai listed companies to activate such activities. Also, for Thai listed companies, they will realize what activities should be more encouraged in order to build up the degree of IC in their organization.

Literature Review

Intellectual Capital (IC) is defined as the sum of useful knowledge (Roos, Roos, Edvinsson, & Dragonetti, 1997; Wang, et al., 2016), the set of valuable intangible assets/resources (Hunter, Webster, & Wyatt, 2005), the non-monetary/non-physical resources, including the composite of wisdom, and the most imperative resources in a modern firm (Mention & Bontis, 2013). With its definition, IC becomes the crucial source of value creation, growth drivers, and competitive advantage that benefits for business success (Bontis, Janošević, & Dženopoljac, 2015). Several researchers (Roos et al., 1997; Tayles et al., 2007) suggested that IC should be measured in order to manage it for a firm's highest benefits. Measuring IC allows influencing the current state and tendencies of IC development, as well as, directions and scales of IC initiatives.

The research dealing with the IC measurement thus has been investigated and the early studies have employed financial and non-financial data that could be quantified to construct the IC

measurement model (Kannan & Aulber, 2004). Later, several approaches have been proposed by various researchers and their development has been reviewed systematically and continuously (e.g. Ferreira et al., 2021; Kannan & Aulber, 2004; Kianto et al., 2020; Pike & Roos, 2007) in order to structure the ideal conceptual framework for IC measurement in an organization. These studies classified the literature based on different criteria. Summary of classifications have been presented in; for instance, Ferreira et al. (2021) and Kianto et al. (2020).

Nevertheless, focusing on types of data used in the IC measurement model, there have been two main groups of research. The first one (Castro, Ramírez, & Escobar, 2021; Jardon & Martinez-Cobas, 2021; Lee & Lin, 2019; Weqar, Sofi, & Haque, 2020) has employed financial and/or non-financial data which can be quantified to measure IC, as stated previously. However, this research has been questioned the validity of the measurement model because the numbers could only capture the measurable components of IC (Kianto et al., 2020), whereas IC is considered to be complicated concept which is required more than measurable components (Kannan & Aulbur, 2004; Kianto et al., 2020), meaning that some IC perspectives have not been recognized in this research group, as they could not be objectively measured. Kianto et al. (2020) also suggested that IC measures currently tend to examine as static concept instead of as continuous activities which, believed, construct IC, and most researchers conceptualize IC as a static asset or stock (Bontis, 1998) and assumes that it is something that can be easily identified, located, moved, and traded like a package, albeit

an intangible one. The further discussion about this IC measurement approach have been indicated in Kianto et al. (2020).

The second group is to employ, what Kannan and Aulber (2004) named, 'perceptual measurement approach'. Intellectual capital has been measured by the perception of people relating to an organization. The researchers believed that IC is extremely complex and not observable and observable indicators that represent IC concept should be identified (Jardon & Martinez-Cobas, 2021; Kianto et al., 2020). Among this group, then, perception of people toward activities or actions in an organization has been recognized as indicators of IC measurement. This approach extended the measures of IC, as the measures are not limited to only quantified indicators. This is agreeable to Kianto et al. (2020) which stated that IC (referred as knowledge) is valuable only when it is used in value-creating activities, so it needs to be measured as a performance or activity rather than as an object. Although Kianto et al. (2020) criticized that this research measured IC at static, rather than continuous, the IC measurement approach among this group seems to unlock the limitation of the first group. Thus, the approach has been applied widely among IC researchers.

Chen et al. (2015) reviewed that the IC measurement framework proposed by Roos et al. (1997) was the earlier work that was employed and then modified by other researchers. After Roos et al. (1997), Bontis' (1998) framework has been used greatly by many researchers, followed by Youndt, Subramaniam, and Snell (2004), and Wang et al. (2016) for instance. Most of the researchers considered that IC consists of (1) Human Capital (HC) refers to the

stored knowledge, skills or experiences, capabilities, including the productivity of an organization (Bontis, 1998; Vidotto, Ferenhof, Selig, & Bastos, 2017), (2) Structural Capital (SC—some called it organizational capital) refers to the knowledge stored in organizational structure, system, and process to create value achieving specific goals for enhancing business competitiveness and benefit (Bontis, 1998; Youndt et al., 2004), and (3) Relation Capital (RC) refers to the knowledge embedded in business relationships, including outside connections of a firm to increase value for success in the long run, such as, customer satisfaction, customer loyalty, customer needs, as well as, partnership developing solutions for employees or stakeholders, and collaboration with each other of employees (Bontis, 1998; Youndt et al., 2004). The research in this group includes, for example, Bontis (1998), Bozbura (2004), Kianto et al. (2017), Novas et al. (2017), and Wang et al. (2016).

Among this research, it is noticeable that IC measurement models varied according to their research objectives and context studied. For instance, Bozbura (2004), based on Bontis (1998) model, developed the IC measurement model consisting of HC, RC, and organizational capital (referred as SC in this current research), in order to measure IC in Turkey. The framework has also been modified and based on the developed market, i.e. Canada and Sweden. The model contained 27 HC items, 21 RC items and 22 items of SC. Using the factor analysis, the research found that in the Turkish context, each component of IC was indicated by one factor each. Unlike Bozbura (2004), Seleim and Khalil (2011) constructed the IC measurement consisting of HC (14-item scale), RC (10-item

scale), and SC (eight-item scale). They tested the data of Egyptian companies in the computer software sector. The IC measurement contains 32 items/questions and after PLS-SEM analysis, the model contains 24 items. Only 8 items were removed.

In the study of Novas et al. (2017) investigating the role of management accounting system in IC development in Portugal, IC measurement model was developed using SEM method. The model was comprised of three components, like others: HC, RC and SC, and based on other previous research with Bontis (1998) as the main one. They found that the IC measurement was likely to consist of 3 HC items, 4 SC items and 4 RC items. The number of indicators of each IC components in Novas et al. (2017) was agreeable with several researchers (e.g. Kianto et al., 2017; Wang et al., 2016).

In the Thai context, the current research had followed the development of IC measurement undertaken by this group of research. There were a few studies dealing with IC in Thailand and they had not addressed this issue. For example, Srivihok (2008) constructed IC measurement for Small and Medium Enterprises (SMEs) by using the data mining techniques and the attributes of IC measurement mainly included non-financial data. Phusavat, Comepa, Sitko-Lutek, and Ooi (2012) studied IC at the national level in order to determine its impact on economic development. Meanwhile, Nimtrakoon (2015) investigated IC among ASEAN countries, including Thailand, using public's Value-Added Intellectual Coefficient model (VAIC) with some modification to measure IC and this study is the only research that selected Thai listed companies as the sample. Recently, Kittikunchotiwut and

Siriyota (2021) studied the impact of IC on knowledge management processes in Thailand among unlisted companies in the fashion industry, but the IC measurement has not been clearly explained. Similar to Srivihok (2008) but having done recently, Na-Nan, Kanthong, Khummueng, and Dhienhirun (2021) determined IC of SMEs, focusing on the hairdressing sector, and indicated that there were two main factors: HC and RC, indicating IC in such industry. However, their result had been limited and very specifically to one sector.

Interestingly, the previous research investigating IC in Thailand had not given much attention to Thai listed companies although their businesses generally require creativity and innovation for competitive advantages more than other business types. Given the lack of research dealing with IC at the corporate level, particularly Thai listed companies, this research developed the IC measurement model, constructing from HC, RC, and SC illustrated in Figure 1.

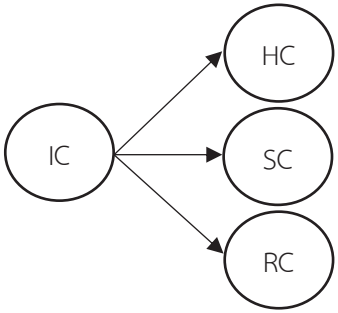

Figure 1. A framework for the IC measurement model

Research Methodology

1. The Development of Research Instrument

As Bontis' (1998) model had been used widely by many researchers (Kianto et al., 2017; Novas et al., 2017; Singh, Sidhu, Joshi, & Kansal, 2016; Vidotto et al., 2017; Wang et al., 2016; Wu, Chang, & Chen, 2008; Youndt et al., 2004) and considered having the comprehensive set of indicators for IC measurement, the current research developed the IC measurement based on this Bontis model. However, as the model was developed since 1998, some updated items were added. In HC part, all items were from Bontis except HC13 that was from Chen et al. (2015) indicating individual's learning skill. For SC measurement, Wang's (2016) item – ability to respond to the changing environment – was added to infer the dynamic environment, as well as other two items related to a role of knowledge in operating process and in creating new products, which were developed by Youndt et al. (2004). Also, in RC measures, two items of Youndt et al. (2004) were added to extend Bontis' (1998) area to cover relationship with various external parties.

The list of indicators was then sent to two Thai professional practitioners and two Thai scholars who are expertise in IC area to ensure the face validity and content validity. The reviewers were required to score for each item from minus one to one (-1, 0, 1) and added the comments if any. If two out of four reviewers scored either minus one or zero to any items, those would be omitted. After the experts' check, the list of IC indicators contained 41 items, including 14 items of HC, 14 items of SC, and 13 items of RC.

The research used a seven-point Likert-type scale ranging from “1” (strongly disagree) to “7” (strongly agree) to measure each item. The respondents were asked ‘To what extent do you agree with the following items describing your organization?’ Therefore, IC was measured based on management’s perception. The more score the respondent selects, the higher level of IC likely exists in a firm.

2. Sample

Thai companies listed on the Stock Exchanges of Thailand (SET) were selected because they were operating in the dynamic environment which required more creativity and innovation for enhance competitive advantages than other groups of businesses. Studying these companies could certainly detect the IC existence. However, financial institutions, service sector, rehabilitated firms, and companies in Market for Alternative Investment (mai) were excluded because their nature of business was different and some operated under specific regulations. The final number of firms was 434 firms and presented in Table 1 Part A. The questionnaires were mailed to all 434 firms at the beginning of February 2021 and CEO/CFO of the companies were asked to provide the assessment of their IC. In total, there were 385 companies responded but 370 answers were valid to do statistical analysis. Table 1 Part B shows the sample classified by industry types.

Table 2 shows characteristics of the sample and the majority of respondents was CEO which ensured that the information given was from reliable source.

Table 1

Part A: The number of sampled companies

Sample	No. of firms
All listed companies (as of March, 2019)	774
Financial institutions, service sector, rehabilitated firms, and companies in mai	(340)
Total	434

Part B: The sampled companies classified by industry

Industry	Sample	%
Agro and Food Industry	38	10.30
Consumer Products	32	8.60
Industrials	98	26.50
Property and Construction	121	32.70
Resources	45	12.20
Technology	36	9.70
Total	370	100

Table 2

Part A: Frequencies of the sample

Characteristics	Number of companies	
	N	%
Current position of the respondents		
Chief Executive Officer (CEO)	282	76.20
Chief Financial Officer (CFO)	22	5.90
Other position	66	17.80

Table 2

Part A: Frequencies of the sample (continued)

Characteristics	Number of companies	
	N	%
Number of Employee		
Less than 100 people	8	2.20
100-300 people	26	7.00
301-500 people	101	27.30
More than 500 people	235	63.50
Main strategy		
Cost leadership strategy	93	25.10
Differentiation strategy	131	35.40
Focus strategy	146	39.50

Part B: Characteristics of the firms

	Min	Max	STD.	Mean
Firm age (Years)	2	129	16.41	34.87

Part C: Characteristics of respondents

Working experience at the current position (Years)	2	8	1.43	3.78

3. Data Analysis

The current research employed the PLS-SEM approach to statistically confirm the IC measurement model for Thai listed companies. The method is an ordinary least square (OLS) regression and was chosen because the normal data distribution is not strictly required. Also, it can work with a complex model with too many measurement items (Hair, Sarstedt, Hopkins, & Kuppelwieser, 2014),

and according to Bontis (1998), many measurement items were suggested for IC construct. Although the normality is not required, this research tested and transformed data for normality in order to strengthen the results by using the Box-Cox method. Furthermore, similar to other previous researchers (Kianto et al., 2017; Novas et al., 2017), the current research assessed the quality of the measurement model by determining indicator reliability, construct reliability, convergent validity and discriminant validity.

Research Results and Discussion

1. Descriptive Statistics

Table 3 showed the perception of the respondents about IC in their companies. Human capital had the highest average score, suggesting that the respondents believed their company operating the activities indicating the possibility of HC at the high level. The results of other components, SC and RC, also showed the high average score.

Table 3
Descriptive statistics of intellectual capital (N=370)

Intellectual Capital	Min	Max	S.D.	Mean
Human Capital (HC)	4.83	6.92	.46	6.02
Structural Capital (SC)	4.08	7.00	.57	5.89
Relation Capital (RC)	4.25	7.00	.52	5.91

2. The IC Measurement Model

Table 4 showed the results of reliability and validity of the measurement model. The table revealed the factor loadings of the indicators of each component. The values that were less than 0.6 were removed, as Hair, Risher, Sarstedt, and Ringle (2019) suggested that loadings should indicate that the construct explained more than 50 per cent of the indicator's variance, providing acceptable item reliability.

Thus, there were 11 remaining indicators. These included four of HC, four of SC, and three of RC. The value of CR ranged from 0.811 to 0.832, which were considered 'satisfactory to good' in term of internal consistency reliability (Hair et al., 2019). The values of Cronbach's alpha ranged from 0.675-0.732 also confirmed the internal consistency reliability. Furthermore, in Table 4, the values of AVE ranged from 0.518-0.590, suggesting no serious concern for the convergent validity of the model (Hair et al., 2019).

The result of Fornell and Larcker's (1981) criterion to check the model's discriminant validity was presented in Table 5. The constructs in the model had discriminant validity. All square roots of AVE values in the diagonal (in bold) elements were greater than values in the non-diagonal elements.

Table 4

Factor loadings, AVE, CR, and Cronbach's alpha of IC indicators

Indicators	loadings	Cronbach's alpha	CR	AVE
Human Capital		**0.693**	**0.811**	**0.518**
HC6: The employees of our firm are considered creative and bright. (Bontis, 1998)	0.688			
HC12: Our employees generally give it their all which makes this firm different from the others in the industry. (Bontis, 1998)	0.724			
HC13: Problems here are easy to solve once the employees understand the various consequences of their actions, a skill they have acquired. (Chen et al., 2015)	0.720			
HC14: Individuals learn from others to solve problems. (Bontis, 1998)	0.746			
Structural Capital		**0.732**	**0.832**	**0.554**
SC3: The time it takes to complete one whole transaction has been decreasing over the past 2-3 years. (Bontis, 1998)	0.712			

Table 4

Factor loadings, AVE, CR, and Cronbach's alpha of IC indicators. (continued)

Indicators	loadings	Cronbach's alpha	CR	AVE
SC5: Our company develops more new ideas and products than any other firm in the industry. (Bontis, 1998)	0.746			
SC7: Our data systems make it easy to access relevant information. (Bontis, 1998)	0.728			
SC9: The procedures of the organization support innovation. (Bontis, 1998)	0.789			
Relation Capital		**0.675**	**0.811**	**0.590**
RC2: We have greatly reduced the time it takes to resolve a customer's problem. (Bontis, 1998)	0.817			
RC4: Our market share is highest in the industry at the top three. (Bontis, 1998)	0.769			
RC6: Over the past 2-3 years, when it comes to new business, our customers have increasingly selected us versus our competitor's customers. (Bontis, 1998)	0.748			

Table 5

Fornell-Larcker test for discriminant validity

Constructs	HC	RC	SC
HC	**0.720**		
RC	0.354	**0.778**	
SC	0.421	0.292	**0.744**

In addition, the bootstrap was undertaken and its result showed that the t-value of all constructs was significant consistently. Also, the model fit was tested and the result shows an acceptable fit with the SRMR value of 0.028 (less than 0.05), according to Henseler (2017).

Considering in detail, for HC construct, the research found the four indicators (HC6, HC12, HC13, HC14) relating to individual's ability, creativity, and good attitude (creative and bright, and giving their all) and learning skill (able to solve problems). The result had some similarities to Kianto et al. (2017) and Novas et al. (2017) showing individual's competency, creativity, and learning skill to indicate HC. It is noticeable that in Thai context, the team-working indicators, had not shown the significant part. This insignificance was interesting as Thailand was ranked high degree of collectivism (Engelen, Flatten, Thaimann, & Brettel, 2014), so teamworking was expected to drive business. This suggests that working as a team might exist in a firm but it had not strongly driven evidently fruitful outcome for business, i.e. HC. Engelen et al. (2014) also supported this view that teamwork was not a significant factor in producing

firms' propensity to engage in innovation, risk-taking, and proactive opportunity-seeking.

For SC, four indicators (SC3, SC5, SC7, SC9) were statistically significant, indicating that procedures and information system in Thai listed companies which facilitated working procedures, new ideas and innovation significantly reflected SC. The indicator—easily accessible information system—was agreeable with the model by other previous research (Kianto et al., 2017; Novas et al., 2017; Youndt et al., 2004). However, other indicators are different, such as the system to manage knowledge and information, which was the SC indicator in Youndt et al. (2004) and Kianto et al. (2017), but not a significant indicator of SC in Thailand. This is probably because management in Thai listed companies considered operational system and a system for knowledge storage as usual systems, whereas processes and systems facilitating innovations was considered as purposive structure.

The result of RC was quite different from other previous research. While other researchers (Kianto et al., 2017; Novas et al., 2017; Wang et al., 2016) found that ‘good relationship with customers, suppliers and business partners’ was a statistically significant indicator of RC, the current research found insignificant. This implies that in Thai context, the companies considered customer-focused as the most important source of their business growth, while other stakeholders possibly were important at the certain degree.

Conclusion

The research aimed to search for the measurement model of intellectual capital in Thailand. The result revealed that in Thai context, HC was reflected through employee's ability of learning and his/her good attitude toward a firm, while SC indicators were related to the procedures and information system that allowed new ideas and innovation to emerge. For RC, the important indicators were mainly customer-focused, particularly in a part of customer services and a firm's market share. The model suggested that management in the Thai listed companies possibly had not perceived some activities which could help to strengthen IC in an organization. For HC, team-working activities seems to be overlooked while the SC indicators excluded a system of managing knowledge and information. Also, in the Thai context, the management was unlikely to give much attention to the relationship with suppliers and alliance partners for building up RC. The model potentially guided management to be aware of the activities which could strengthen its firm's IC, and consequently, enhance its competitiveness. It also directed the regulators to introduce the policy encouraging Thai companies to recognize the activities that might improve their IC.

Although the current research reveals some interesting points of IC measurement model in the Thai context, its limitation should be aware. The results should be interpreted cautiously, due to doubts on the statistical ability of PLS-SEM approach raised by Rönkkö, McIntosh, and Antonakis (2015). The research also investigated only limited perspective of IC, whereas Kianto et al. (2020) suggested that knowledge could not be easily measured as it

was an institutional and collective phenomenon. Thus, an in-depth study investigating the IC measurement is required. Furthermore, the measurement model proposed may only be valid at the point of time, but not for overtime, and this limited the research not possible to determine the changes in IC measurement model overtime, leaving a room for future research to determine IC model overtime, as Kianto et al. (2020, p. 9) indicated that,

> 'Knowledge is dynamic: It is continuously reinterpreted and modified and is related to learning and change..... the applicability of knowledge varies over time, and knowledge is bound by the interpretations of what is valuable now and in the future.'

References

Bontis, N. (1998). Intellectual capital: An exploratory study that develops measures and models. *Management Decision*, *36*(2), 63-76.

Bontis, N., Janošević, S., & Dženopoljac, V. (2015). Intellectual capital in Serbia's hotel industry. *International Journal of Contemporary Hospitality Management*, *27*(6), 1365-1384.

Bozbura, F. T. (2004). Measurement and application of intellectual capital in Turkey. *The Learning Organization*, *11*(4/5), 357-367.

Castro, J. P. G., Ramírez, D. F. D., & Escobar, J. M. (2021). The relationship between intellectual capital and financial performance in Colombian listed banking entities. *Asia Pacific Management Review*, *26*(4), 237-247.

Chen, J., Zhao, X., & Wang, Y. (2015). A new measurement of intellectual capital and its impact on innovation performance in an open innovation paradigm. *International Journal Technology Management*, *67*(1), 1-25.

Engelen, A., Flatten, T. C., Thalmann, J., & Brettel, M. (2014). The effect of organizational culture on entrepreneurial orientation: A comparison between Germany and Thailand. *Journal of Small Business Management*, *52*(4), 732-752.

Ferreira, J. J., Fernandes, C., & Veiga, P. (2021). Multilevel approaches to advancing the measurement of intellectual capital research field–What can we learn from the literature?. *Journal of Intellectual Capital*, *22*(6), 971-999.

Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *European Business Review*, *31*(1), 2-24.

Hair, J. F., Sarstedt, M., Hopkins, L., & Kuppelwieser, V. G. (2014). Partial least squares structural equation modeling (PLS-SEM): An emerging tool in business research. *European Business Review, 26*(2), 106-121.

Henseler, J. (2017). Partial least squares path modeling. In P. S. H. Leeflang, J. E. Wieringa, T. H. A. Bijmolt, and K. H. Pauwels (Eds.), *Advanced Methods for Modeling Markets* (pp. 361-381). International Series in Quantitative Marketing. Springer, Cham. https://doi.org/10.1007/978-3-319-53469-5_12

Huang, C. C., & Huang, S. M. (2020). External and internal capabilities and organizational performance: Does

intellectual capital matter? *Asia Pacific Management Review*, *25*(2), 111-120.

Hunter, L., Webster, E., & Wyatt, A. (2005). Measuring intangible capital: A review of current practice. *Australian Accounting Review, 15*(36), 4-21.

Jardon, C. M., & Martinez-Cobas, X. (2021). Measuring intellectual capital with financial data. *PLOS ONE, 16*(5), e0249989. https://doi.org/10.1371/journal.pone.0249989

Kannan, G., & Aulbur, W. G. (2004). Intellectual capital: Measurement effectiveness. *Journal of Intellectual Capital*, *5*(3), 389-413.

Kianto, A., Ritala, P., Vanhala, M., & Hussinki, H. (2020). Reflections on the criteria for the sound measurement of intellectual capital: A knowledge-based perspective. *Critical Perspectives on Accounting*, *70*(July), 1-15. https://doi.org/10.1016/j.cpa. 2018.05.002

Kianto, A., Sáenz, J., & Aramburu, N. (2017). Knowledge-based human resource management practices, intellectual capital and innovation. *Journal of Business Research*, *81*(December), 11-20. https://doi.org/10.1016/j.jbusres.2017.07.018

Kittikunchotiwut, P., & Siriyota, K. (2021). The impact of intellectual capital on knowledge management processes in Thailand. *The Journal of Asian Finance, Economics and Business, 8*(9), 249-260.

Lee, C. C., & Lin, C. K. (2019). The major determinants of influencing the operating performance from the

perspective of intellectual capital: Evidence on CPA industry. *Asia Pacific Management Review*, *24*(2), 124-139.

Loyarte, E., Garcia-Olaizola, I., Marcos, G., Moral, M., Gurrutxaga, N., Florez-Esnal, J., & Azua, I. (2018). Model for calculating the intellectual capital of research centres. *Journal of Intellectual Capital*, *19*(4), 787-813.

Mention, A. L., & Bontis, N. (2013). Intellectual capital and performance within the banking sector of Luxembourg and Belgium. *Journal of Intellectual Capital, 14*(2), 286–309.

Na-Nan, K., Kanthong, S. N., Khummueng, K., & Dhienhirun, A. (2021). Intellectual capital of SMEs in Thailand: An employee behavioural measurement instrument. *International Journal of Organizational Analysis, 29*(4), 825-846.

Nimtrakoon, S. (2015). The relationship between intellectual capital, firms' market value and financial performance: Empirical evidence from the ASEAN. *Journal of Intellectual Capital, 16*(3), 587-618.

Novas, J. C., Alves, M. D. C. G., & Sousa, A. (2017). The role of management accounting systems in the development of intellectual capital. *Journal of Intellectual Capital*, *18*(2), 286-315.

Phusavat, K., Comepa, N., Sitko-Lutek, A., & Ooi, K. B. (2012). Intellectual capital: National implications for industrial competitiveness. *Industrial Management & Data Systems*, *112*(6), 866-890.

Pike, S., & Roos, G. (2007). Recent advances in the measurement of intellectual capital: a critical survey. The *8th European Conference on Knowledge Management, Barcelona*.

Rehman, S. U., Bresciani, S., Ashfaq, K., & Alam, G. M. (2021). Intellectual capital, knowledge management and competitive advantage: A resource orchestration perspective. *Journal of Knowledge Management*, DOI: 10.1108/JKM-06-2021-0453

Roos, J., Roos, G., Edvinsson, L., & Dragonetti, N. C. (1997). *Intellectual Capital: Navigating the New Business Landscape*. Palgrave Macmillan. London.

Rönkkö, M., McIntosh, C. N., & Antonakis, J. (2015). On the adoption of partial least squares in psychological research: Caveat emptor. *Personality and Individual Differences*, *87*(December), 76-84. https://doi.org/10.1016/j.paid.2015.07.019

Seleim, A. A., & Khalil, O. E. (2011). Understanding the knowledge management-intellectual capital relationship: A two-way analysis. *Journal of Intellectual Capital*, *12*(4), 586-614.

Singh, S., Sidhu, J., Joshi, M., & Kansal, M. (2016). Measuring intellectual capital performance of Indian banks: A public and private sector comparison. *Managerial Finance*, 42(7), 635-655.

Srivihok, A. (2008). Intellectual capital of enterprises in Thailand: Measurement model by Baysean Network Algorithm. *Communications of the IBIMA*, *3*(26), 193-199.

Tayles, M., Pike, R. H., & Sofian, S. (2007). Intellectual capital, management accounting practices and corporate performance: Perceptions of managers. *Accounting, Auditing & Accountability Journal*, *20*(4), 522-548.

Vidotto, J. D. F., Ferenhof, H. A., Selig, P. M., & Bastos, R. C. (2017). A human capital measurement scale. *Journal of Intellectual Capital*, *18*(2), 316-329.

Wang, Z., Wang, N., Cao, J., & Ye, X. (2016). The impact of intellectual capital-knowledge management strategy fit on firm performance. *Management Decision, 54*(8), 1861-1885.

Weqar, F., Sofi, Z. A., & Haque, S. I. (2020). Nexus between intellectual capital and business performance: Evidence from India. *Asian Journal of Accounting Research*, *6*(2), 180-195.

World Intellectual Property Organization (WIPO) (2019). *Global Innovation Index 2019*. https://www.wipo.int/global_innovation_index/en/2019

World Intellectual Property Organization (WIPO) (2022). *Global Innovation Index 2022*. https://www.wipo.int/global_innovation_index/en/2022

Wu, W. Y., Chang, M. L., & Chen, C. W. (2008). Promoting innovation through the accumulation of intellectual capital, social capital, and entrepreneurial orientation. *R&D Management*, *38*(3), 265-277.

Youndt, M. A., Subramaniam, M., & Snell, S. A. (2004). Intellectual capital profiles: An examination of investments and returns. *Journal of Management Studies, 41*(2), 335–361.