GENERAL MANAGEMENT

Intellectual Capital Measurement Revisited: Bibliometric Analysis of Value-Added Intellectual Coefficient

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Abstract

Compared to other intellectual capital measurement methods, VAIC (Value-Added Intellectual Coefficient) is the most preferred one by scholars in carrying out their research. Its popularity can be proven by numbers of research published that use VAIC in the international reputable journals. Despite its popularity, critics have also been addressed by some researchers regarding the inconsistency and unclear conceptual issue inherent in VAIC formulation. The objective of the article is exploring the use of VAIC in research and publication to find the paths for the future research avenue. To achieve the objective, this research will apply bibliometric analysis on 130 research and publications of VAIC for period 2016-2020 in Scopus database. Further analysis will be done by reading the abstract, conclusion and/or introduction of the 50 most-cited articles to get more insight on the topic. The result shows that there are interesting opportunities for VAIC research ahead, especially in modifying VAIC model by including other factors such as innovation and relational capital. Relationship of VAIC research with corporate governance and sustainability issues, especially in green economy era are also other research area that can be explored in the future. The originality of this paper is the use of bibliometric analysis on VAIC publications as a main issue.

Keywords: *VAIC, bibliometric analysis, modified VAIC (M-VAIC), Intellectual capital measurement*

Introduction

The term intellectual capital (IC) was first introduced by John Kenneth Galbraith in 1969 (Hsu and Fang, 2009; Xu and Li, 2022) which described it as the process of value creation that brings impact to the difference between an organization's market value and book value. IC is generally acknowledged as the source of competitive advantage and future value creation in today's knowledge-based economy (Petty and Guthrie, 2000; Dzenopoljac et al., 2017; González, Calzada and Hernández, 2017; Smriti and Das, 2018; Xu, Haris and Yao, 2019). IC is the main drivers of value creation (Dzenopoljac et al., 2017; González, Calzada and Hernández, 2017). Despite its significant roles in the company, the existence of IC in the company still cannot be reflected on the financial statement (González, Calzada and Hernández, 2017). Financial statements tend to report more on the physical or tangible assets and intangible assets such as patent, copyright, etc. However, employees' knowledge and competencies, customer relationship, structural capital as new intangible resources still cannot be reported on the financial statements (Petty and Guthrie, 2000; González, Calzada and Hernández, 2017). In this sense, these new intangible assets are part of IC. The main challenge to include IC in the financial statement is on how to define it and how to have a sound measurement on it (Kehelwalatenna, 2016).

Numerous efforts have been carrying on by scholars throughout the world to address these issues. Effort to measure IC has been done using quantitative and qualitative measurements (Dzenopoljac et al., 2017). First approach is using the intellectual capital's intrinsic value. In this approach, IC is measured and assessed directly by company managers. Second approach focuses on visualizing it through various scorecard approaches. Skandia Navigator is one of the example in this category. Other effort is assessing its absolute monetary value, such as Calculated Intangible Value and Value Added Intellectual Coefficient (VAIC) which attempts to measure intellectual capital's relative contribution to corporate performance (Dzenopoljac et al., 2017).

Exploring the research on each IC measurement abovementioned, Table 1 and Table 2 show the use of each measurement in the publication documents in Scopus database populated using Publish or Perish Software for the period 2016-2020. Certain phrase(s) as keywords which are used in finding the document in this software are listed on Table 1. As revealed in this table, basically, keywords used is (are) the name(s) of the measurement itself, except for Balance Score Card or BSC, Economic Value Added or EVA, Tobins Q, Technology Brokers and IC Index. For these terms, keywords were added with AND "Intellectual Capital" OR "IC" for the secondary filter since that terms are too general. Searching without secondary filter resulted hundreds of papers on Scopus database using those

specified criteria. Nevertheless, these papers do not discuss the intellectual capital issues and even the content of document came from other disciplines such as engineering and health science. Secondary filter is used for narrowing the result that they will be match with the issued being researched, which is intellectual capital.

No	Measurement	Keywords
1	VAIC	VAIC OR "Value Added Intellectual Coefficient"
2	BSC	"Balance Scorecard" OR "BSC" AND "Intellectual Capital" OR "IC"
3	EVA	"Economic Value Added" OR "EVA" AND "Intellectual Capital" OR "IC"
4	Tobins' Q	"Tobins' Q" OR "Tobin's Q" OR "tobins Q" OR "Tobin Q" AND "intellectual capital" OR "IC"
5	Technology Brokers	"technology brokers" OR "technology broker" OR "technology broker'"AND "intellectual capital" OR "IC"
6	Skandia Navigator	"skandia navigator"
7	IC index	"intellectual capital" AND "IC index" OR "IC-index"
8	Intangible Assets Monitor	"intangible assets monitor"
9	Calculated intangible value	"calculated intangible value"

Table 1. Keywords used for each measurement in populating the document
(Source : Result from Publish or Perish Software)

Table 2 shows a very interesting phenomena, which VAIC the most used in the research of IC measurement context. There are 162 documents found with

No	Measurement	Total documents	Articles	Reviews	Conference Papers	Book Chapters	Citations
1	VAIC	162	142	3	13	4	1920
2	BSC	18					155
3	EVA	16					131
4	Tobins' Q	23					232
5	Technology Brokers	1			1		1
6	Skandia Navigator	3	1		2		2
7	IC index	4	3	1			45
8	Intangible Assets Monitor	4	4				18
9	Calculated intangible value	5	4	1			16

Table 2. Number of research documents using various IC measurement
(Source : Result from Publish or Perish Software)

1920 citations. Second measurement that relates to IC measurement is Tobins Q with 23 documents and 232 citations are located. However, these numbers are very far behind the ones revealed by VAIC measurement. It brings VAIC as the most popular research in IC measurement compared to other measurements listed in Table 1. There are several reasons for VAIC popularity, such as the data needed for calculating the VAIC is easily accessible, since the data are taken from the financial statement that available in a public database. It also guarantees for the objectivity, consistency, comparability, reliability and it is also simple in its application (Al-Musali and Ku Ismail, 2016; Ginesti, Caldarelli and Zampella, 2018;

Bayraktaroglu, Calisir and Baskak, 2019; Singla, 2020; Pratama, Kamaluddin and Saad, 2022).

Large number of researchers carry on their study on the relationship between firm performance and IC using VAIC (Value-Added Intellectual Coefficient) as a measurement tool (Ståhle, Ståhle and Aho, 2011; Maji and Goswami, 2016). VAIC is a measurement tool proposed by Pulic around twenty years ago. It is a measure of intellectual capital efficiency which are consistent with the knowledge-based economy (Marzo, 2021). VAIC is the result of the sum of three efficiency ratios that obtained through the combination of the value added of three types of capital, which are capital employed (physical and financial capital) as well as intellectual capital that consist of human capital and structural capital (Marzo, 2021). However, there are some questions on the validity of the VAIC methods as an indicator of IC (Ståhle, Ståhle and Aho, 2011).

The main reason for critics is VAIC parameters have nothing to do with IC, since it merely measures the efficiency of the workforce and capital investment (Ståhle, Ståhle and Aho, 2011). There must be unrevealed factors that can explain the inconsistent behavior of the model because of the use of value added as a central figure in the VAIC formula that in fact, it is dynamic and volatile (Ståhle, Ståhle and Aho, 2011). The newly published article on the theoretical analysis explains seven items critics on VAIC (Marzo, 2021), such as VAIC focuses of the efficiency of IC and not the role of IC; it also neglected relational capital on the formula developed; it views SCE (structural capital efficiency) is simply a function of the invers HCE (human capital efficiency) which is unclear from the theoretical perspectives; it neglects the interactions among different kinds of capital; it has a time mismatch between the incurrence of workforce cost and value generation; it has ambiguities on the role and meaning of HCE. This ambiguity happened because VAIC does not address the role of governance system as the central issues and it has overlapping perspectives of production and distribution. Two research on VAIC critics were addressed in 2011 by Stahle et al. and in 2021 by Marzo, et al., however, the later posits even more critics on VAIC.

This paper will explore how VAIC research were done during 2016-2020. Does VAIC still relevant for the IC research in the future, while business now entering new era? How is the future research avenue on VAIC? To answer these questions, this article will be written in the following sections, research methodology, then finding and discussion, and conclusion.

Research Methodology

Bibliometric analysis is applied to answer the question addressed in this study. The bibliometric analysis is carried out by identifying and analyzing the most relevant journals, articles, authors and keywords (Ferenhof et al., 2014) to find the influential studies and current research interests that will open the paths for the future research agenda. This study will use five steps methodology which are (1) defining appropriate search terms (2) initial search results (3) refinement of the search results (4) initial data statistics and (5) data analysis (Fahimnia, Sarkis and Davarzani, 2015; Indarti et al., 2021). In the analysis step, 10 most-cited articles for each year observation will be explored further through reading the abstract, conclusion and/or introduction to get more insight on the topic being discussed. Several software, such as Publish or Perish software, MS Excel, Mendeley and also VOS Viewer are used to assist this study. The latest is software to facilitate bibliometric mapping approach that is rely on computer program and sophisticated visualization (Heersmink et al., 2011).

Findings and Discussions

Defining appropriate search terms

Based on the topic of the study, the keyword used is VAIC OR "Value Added Intellectual Coefficient". Software Publish or Perish (PoP) is used to search the publications in Scopus database for the year of 2016-2020 on August 27, 2020. PoP is a free software created by Harzig that can be used for retrieving and analyzing the academic citation, measuring one's research output and searching related articles for literature review (Trau, 2012).

Initial search results

Using PoP software, from the keywords chosen, there are 162 documents in many types of publications, including 142 research articles, 4 book chapters, 3 reviews, 13 conference papers. Table 3 shows the result in detail. This study only use research articles type of document and exclude the other ones. Based on Table 3, this type of document consists of 142 articles and those will be used for the study. However, further examination revealed that not all research articles fulfil the criteria. There are 136 out of 142 documents that can be used since 5 research articles come from other disciplines, such as psychiatry, pharmacy, neuroscience and zoology. While there is also one article that is duplicated. Excluding 6 research articles, there will has an impact on reducing 15 citations only from all the articles under study, from 1578 to 1563 citations.

For further step, refinement of the search result, there will be 136 articles used, 20 articles from 2016, 17 articles from 2017, 18 articles from 2018, 32 articles from 2019 and 49 articles form 2020.

	2016	2017	2018	2019	2020	total
Total record /publications identified						162
-book chapter		1	1	2		4
-conference paper	3	2	3	3	2	13
-review				2	1	3
-journal articles	20	17	19	35	51	142
'- duplicate				1		1
'-other discipline			1	2	2	5
-journal articles used for analysis	20	17	18	32	49	136

Table 3. Type and number of publication per year

Refinement of the search results

There are 5 steps in the refinement of the search results (1) classifying the articles based on the rank of journals from ScimagoJR website (2) Select articles from reputable peer-reviewed journal – rank Q1 until Q4 (3) Re-review articles from unranked journals (4) Re-scrutiny them (5) Final selection (Indarti et al., 2021). However, this study will follow the first two steps, since one of the search criterion is all the articles must be indexed by Scopus. This criterion has been applied at the first time, when searching the intended articles using Scopus database facilitated by PoP software.

After matching all the articles and journals under criteria resulted from the previous steps to the ScimagoJR website, there are 6 articles that could not be found on ScimagoJr Rank, leaving 130 articles for further process. Efforts to find information for the 6 articles whether they have been indexed in Scopus or not, unfortunately did not bring any conclusive evidence. These 6 articles are excluding from the study. The effect of the exclusion on the number of citation is only a little reduction of citations, from 1563 to 1547, which is 16 citations.

Continuing refinement process, there are 25 articles published in journals that has been discontinued by Scopus when this study was carried on. These 25 articles will be included in step (3) and (4) as long as the data are available. Unfortunately, in several part of the discussion in step (3) and (4), these 25 articles must be excluded because of the unavailability of the data. However, they will still be included in the analysis for the content of the articles or step (5) data analysis of the articles. Figure 1 shows the status of articles in ScimagoJr Rank per year from 2016-2020.

	2016 open access	2016 restricted acces	2017 open access	2017 restricted acces	2018 open access	2018 restricted acces	2019 open access	2019 restricted acces	2020 open access	2020 restricted acces	Total open access	Total restricted acces	total
journal rank													
Q1	2	3	1	1		5	4	7	2	11	9	27	36
Q2		6	2	1	2	3		4	5	7	9	21	30
Q3	1	4	3	7	2	3	4	3	3	3	13	20	33
Q4						1		3	2	0	6	0	6
sub-total	3	13	6	9	4	12	8	17	10	23	31	74	105
indexed by scopus-active	16		15		16		25		33				105
Discountinued	4		2		2		9		8				25
Total publication - active status	20		17		18		34		41				130
N.A	0		0		0		1		5				6
Total	20		17		18		35		46				136

Figure 1. Articles' status in ScimagoJr Rank

Excluding the discontinued journals, Figure 2 revealed trends of VAIC publication in ScimagoJr Rank journals. Trends of publication for all ranks, from Q1-Q4 mostly increasing every year under the period of study. The highest increase is in 2019-2020 for Q2 publication. Trends of total publication shows that more and more scholars are interested in the discussion of VAIC and they tend to publish their research in a qualified or top rank journals.
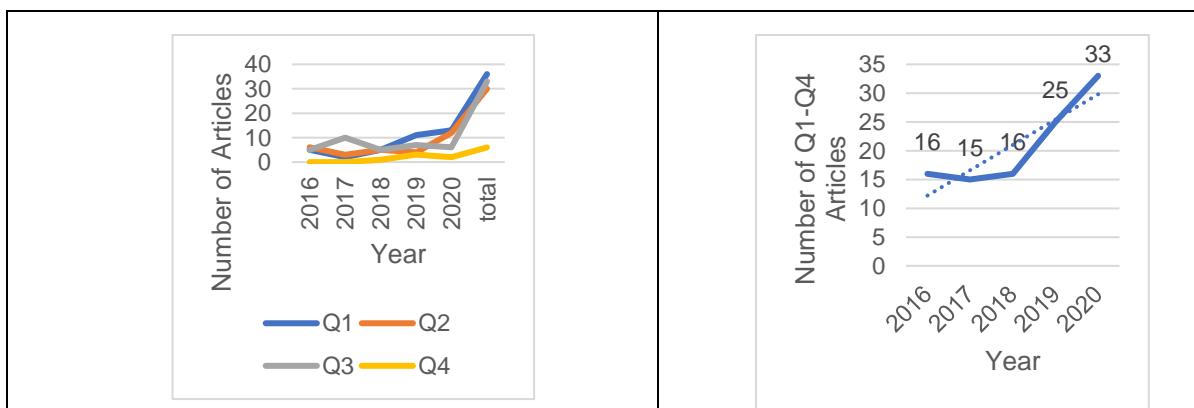

Figure 2. Trends of VAIC publication in the Scopus journals

Opportunity for new scholar to publish in Scopus rank journals on this topic is also still high since the publication in Q3-Q4 journal is only 37% from 2016-2020. Support from open access journal on the Scopus database associated with the topic of study is almost 30% of the number related articles published. Open access journals definitely will facilitate the accessibility of qualified references for those who want to do research on this topic.

Referring to the publishers and their country of origin, from 130 articles, as shown from Figure 3, the five biggest publishers are Emerald Group Publishing Ltd, Inderscience Enterprises, Ltd, Institute of Advance Scientific Research, MDPI AG (Multidiciplanary Digital Publishing Institute) and Springer. Emerald Group Publishing issued the biggest portion of article discussing about VAIC or value added intellectual capital. It was about 36% of articles that discussing value added intellectual

coefficient on the Scopus database for the year of 2016-2020. Twenty-five articles from the discontinued journals are included in Figure 3 and Figure 4. Data regarding the publishers and their countries of origins are clearly stated in the ScimagoJr database, although the status of those journals have been discontinued already.
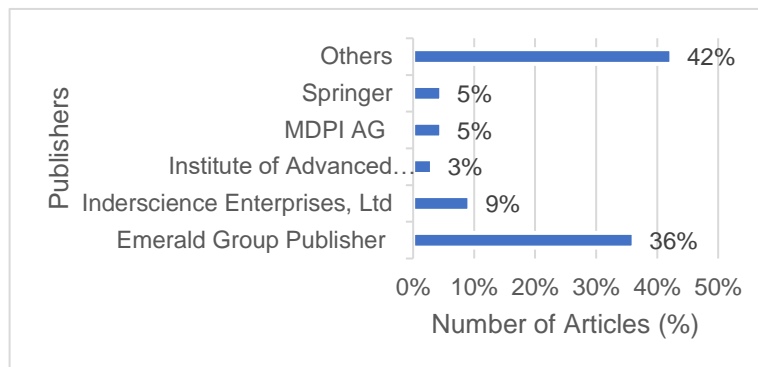

Figure 3. Five Biggest Publishers and Percentage of Publications

Figure 4 shows that United Kingdom contributes the highest number of Q1-Q3 articles, mostly from 16 different journals under umbrella of Emerald Group Publishing. Almost half (48%) of international reputable articles discussing VAIC in Scopus database in the year of 2016-2020 were issued in UK, leaving the US far behind it. The US only contribute 10% of articles in the Scopus database. However, if discontinued journals are excluded from this computation, Switzerland will be in the second place after UK, followed by the US since there were some journals in the US that has been discontinued from Scopus Rank. Although India's contribution was 9%, higher than Switzerland, but there were some discontinued journals in India as well. After excluding the discontinued journals, India and Germany have the same contribution in this publication. Both countries will be in the list after the US. This description relates with Figure 3. Switzerland and Germany contribution mostly come from MDPI and Springer which are in the top five publishers listed in the abovementioned figure.
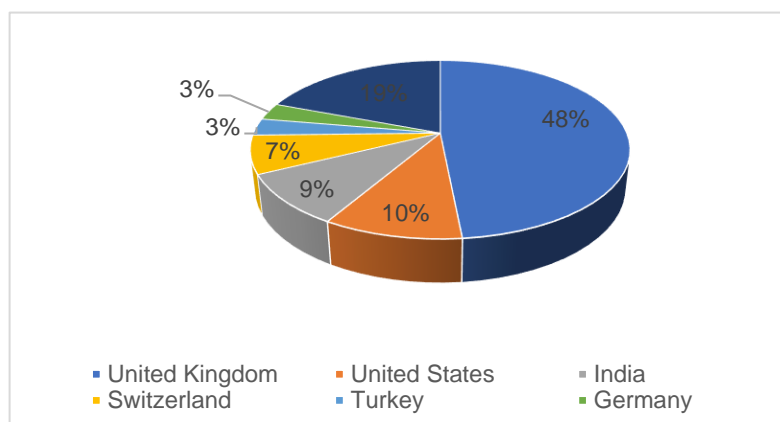

Figure 4. Countries and percentage of publications

The 130 articles under examination were published in 72 journals. Table 3 shows top eight journals based on the number of articles published. It seems that the top two journals which publish the most articles are the journal which address specific issues in the topic under review, as reflected on their names, Journal of Intellectual Capital (Q1) and International Journal of Learning and Intellectual Capital (Q3). More than 40% articles under examination or 54 articles were published there. These journals were established in 2000 and 2004. It means they have already been publishing articles for 20 and 16 years. Seven articles out of 54 articles were published in journals which were discontinued in 2020. These two journals were the youngest journals among the top eight journal, which were 6 years and 2 years old. They are Journal of Advance Research in Dynamical and Control Systems and International Journal of Scientific and Technology Research.

No	Name of Journals	Number of Articles	Rank	Coverage
1	Journal of Intellectual Capital	23	Q1	2000-2020
2	International Journal of Learning and Intellectual Capital	10	Q3	2004-2020
3	Sustainability (Switzerland)	5	Q1	2009-2020
4	Journal of Advanced Research in Dynamical and Control Systems	4	discontinued	2009-2015; 2017-2020
5	Indian Journal of Finance	3	Q4	2013-2020
6	International Journal of Islamic and Middle Eastern Finance and Management	3	Q2	2008-2020
7	International Journal of Scientific and Technology Research	3	discontinued	2018-2020
8	Journal of the Knowledge Economy	3	Q2	2010-2020

Table 4. Top Eight Journals Based on Number of Article Published

Another metric which is very important in considering the quality of publication is number of citations. Higher citation means higher influence other articles published. Table 5 depicts list of top ten journals based on the number of citations.

No	Name of Journal	Number of Citations	Rank	Journals' Age (year)
1	Journal of Intellectual Capital	570	Q1	20
2	International Journal of Learning and Intellectual Capital	101	Q3	16
3	Borsa Istanbul Review	84	Q2	7
4	International Journal of Islamic and Middle Eastern Finance and Management	82	Q2	12
5	Journal of Multinational Financial Management	53	Q2	23
6	Journal of Islamic Accounting and Business Research	49	Q3	10
7	Knowledge and Process Management	46	Q3	23
8	Managerial Finance	43	Q3	24
9	Sustainability (Switzerland)	42	Q1	11
10	Management Decision	38	Q1	53

Table 5. Top Ten Journals Based on the Number of Citations

Instead of top two journals in publishing the most articles, Journal of Intellectual Capital and International Journal of Learning and Intellectual Capital are also become top two journals which are the most cited. Tabel 5 shows that Journal of Intellectual Capital's number of citation is 570, more than 5.5 times citation of the second most cited one, Journal of Learning and Intellectual Capital. Journal of Intellectual Capital is indexed in prominent journal citation report, such as Web of Science (WoS) and Scopus. Its citation index is 6.48, place it in the top or first quartile in business and management category (Bamel et al., 2020). While Journal of Learning and Intellectual Capital is in the third quartile journal in business and management category as well.

As shown in Table 5, there are 3 journals for Q1 and Q2 rank and 4 journals have Q3 rank. It means that the discussion of VAIC are still relevant and draw attention from highly respected journals. Comparing Tabel 4 and Table 5, there are 4 journals that appears in both tables. These journals are listed in Tabel 6. In term of number of citation per article for these four journals, it can be seen that International Journal of Islamic and Middle Eastern Finance and Management has already contributed a lot to the VAIC research. Although there are only 3 articles published in this Q2 journal, but number of citation per article is the highest compare to Journal of Intellectual Capital and Journal of Learning and Intellectual. While this journal does not cover a special topic in Intellectual Capital as reflected in their name.

No	Name of Journal	Number of			Rank
		Articles	Citations	Citations per Article	
1	International Journal of Islamic and Middle Eastern Finance and Management	3	82	27.33	Q2
2	Journal of Intellectual Capital	23	570	24.78	Q1
3	International Journal of Learning and Intellectual Capital	10	101	10.10	Q3
4	Sustainability (Switzerland)	5	42	8.40	Q1

Table 6. Number of Citation per Articles in Four Journals

Table 7 shows the top 10 articles which has highest number of citations in Scopus database for the year of 2016-2020. The most cited article is written by Dženopoljac, V., Janoševic, S., & Bontis, N. (2016) with title Intellectual capital and financial performance in the Serbian ICT industry and 99 citations. While the least cited one among these top ten is written by Xu, J., & Li, J. (2019) with title The impact of intellectual capital on SMEs' performance in China: Empirical evidence from non-high-tech vs. high-tech SMEs showing 43 citations.

No	Authors (Year)	Title
1	Dženopoljac, V., Janoševic, S., & Bontis, N. (2016)	Intellectual capital and financial performance in the Serbian ICT industry
2	Ozkan, N., Cakan, S., & Kayacan, M. (2017)	Intellectual capital and financial performance: A study of the Turkish Banking Sector
3	Dzenopoljac, V., Yaacoub, C., Elkanj, N., & Bontis, N. (2017)	Impact of intellectual capital on corporate performance: evidence from the Arab region
4	Smriti, N., & Das, N. (2018)	The impact of intellectual capital on firm performance: a study of Indian firms listed in COSPI
5	Meles, A., Porzio, C., Sampagnaro, G., & Verdoliva, V. (2016)	The impact of intellectual capital efficiency on commercial bank performance: Evidence from the US
6	Nawaz, T., & Haniffa, R. (2017)	Determinants of financial performance of Islamic banks: an intellectual capital perspective
7	Hejazi, R., Ghanbari, M., & Alipour, M. (2016)	Intellectual, Human and Structural Capital Effects on Firm Performance as Measured by Tobin's Q
8	Bayraktaroglu, A. E., Calisir, F., & Baskak, M. (2019)	Intellectual capital and firm performance: an extended VAIC model
9	Ginesti, G., Caldarelli, A., & Zampella, A. (2018)	Exploring the impact of intellectual capital on company reputation and performance
10	Xu, J., & Li, J. (2019)	The impact of intellectual capital on SMEs' performance in China: Empirical evidence from non-high-tech vs. high-tech SMEs

Table 7. Top Ten Articles Based on the Number of Citations

Initial data

Initial data statistics can be extracted from the metric resulted from PoP software. It reveals the metric comparison between the initial search and refined search. Initial search consists of 162 papers with 1631 citations while the refined search consists of 130 papers with 1547 citations.

Data Analysis

Trends of research and publication on VAIC is increasing every year from 2016-2020. Around two-third of VAIC articles published in Q1-Q2 rank in Scopus database, especially from Emerald Group Publisher. Fortunately, there are two highly respected journals which specifically focused on IC research interest, such as Journal of Intellectual Capital (Q1) and Journal of Learning and Intellectual Capital (Q3). The existence of these two journals definitely bring significant contributions to IC research agenda as shown from the high number of citations.

To have better understanding on the research theme or content, 50 out of 130 articles are chosen for further analysis.

These 50 articles are taken from 10 most cited articles every year for five-year observation period. Citations from these 50 articles is 1321, which is 85% from the total citation for 130 article used in this study. From reading the abstract, conclusion and/or introduction sections, some part that can be highlighted in this study. From the 50 most cited articles, around 20 papers take sample from various industries, while sample from one industry mostly come from banking sector (14 papers), financial institutions (4 papers), pharmaceuticals (4 papers) and other sectors, such as ICT, textile, renewable technology industry, real estate, agriculture, SME, etc. Among those research articles, 35 papers take sample from Asian countries, 4 papers from European countries and only 3 papers from US. Only 2 papers discuss the VAIC using cross countries sample.

Most articles used resource-based theory (RBV/RBT), since it views knowledge as a strategic asset for the company that increase the competitive advantages. IC is part of strategic assets because it is recognized as a firm-specific knowledge-related asset which are imperfectly mobile, simultaneously valuable, rare, costly to imitate and non-substitutable (Kehelwalatenna, 2016). Some researcher used it together with knowledge-based theory or KBV (Al-Musali and Ku Ismail, 2016; Amin and Aslam, 2017). According to KBV, IC is more likely contribute to the superior performance achievement compared to the tangible assets. Other theory used are dual theories, which are agency and resource dependency theory (Nadeem et al., 2017; Dalwai and Mohammadi, 2020). Dependency theory states that the survival of the firms depends on the resources which are owned by external forces. It means that the company must bear risk in relying on other external forces to get these

resources. While agency theory focus on reducing the information asymmetry, hence reducing the agency cost, as part of the effectiveness in resource utilization. Variable that reflects these theory is the existence of corporate governance structure or board of director (Dalwai and Mohammadi, 2020), especially its gender diversity for maintaining good relationships with the external environment and add value for the firm (Nadeem et al., 2017). Instead of using the dual theory, agency theory is also used in tandem with corporate governance context (Tran, Van and Vo, 2020). Another theory that used is stakeholder theory. This theory relates with the value addition of the company that originates from the accumulations of all the value creations to the stakeholder (Kehelwalatenna, 2016).

Based on the theories abovementioned, the topic discussion of the articles under analysis can be classified into three categories. First category is on the impact of IC on firm performance. Most research from 50 articles being analyzed fall under this category. As revealed in Table 8, independent variable used is IC with human capital, structural capital and capital employed with their variation such as, their efficiency, their value-added or lagged variation, including the use of VAIC. However there are several researchers using relational capital as part of IC component (Ulum, Kharismawati and Syam, 2017; Anifowose et al., 2018; Vidyarthi and Tiwari, 2019; Xu and Li, 2019; Tran, Van and Vo, 2020). Other IC components used are innovation (Anifowose et al., 2018; Nadeem, Dumay and Massaro, 2019), process capital and protection capital which is intellectual assets covered by legal protection (Anifowose et al., 2018).

INTELLECTUAL CAPITAL	FIRM PERFORMANCE	OTHERS
* Human capital (efficiency)	*Profitability (ROA, ROE, ROI, ROC)	CORPORATE GOVERNANCE
* Structural capital (efficiency)	*Productivity (ATO, Malmquist productivity index, employee productivity)	(board size, independent board, board remuneartion, board gender diversity, ownership, duality of CEO)
* Capital employeed (efficiency)		
* Relational capital (efficiency)	*Market value (Tobins' Q, market to book value, growth opportunity)	
* Innovation capital (efficiency)		
* Process capital (efficiency)	*Earning (EBIT, EBITDA, EPS, PER)	
* Protected capital (efficiency)	*Others (EVA, reputation, export performance, sales growth, etc)	CORPORATE SUSTAINABILITY
* VAIC		
* M-VAIC		

Table 8. Variables used in the 50 articles under study

Firm performance as dependent variable is represented by profitability, productivity, market value, earning etc. From Table 8, ROA, ROE, ATO and Tobins'Q (Hejazi, Ghanbari and Alipour, 2016; Sherif and Elsayed, 2016; Hamdan, 2018; Smriti and Das, 2018) are the most used variables in those articles. This might be aligned with the way how VAIC correlates with economic performance as measured by return on assets (ROA) and return on investment (ROI) when it was first hypothezed (Ståhle, Ståhle and Aho, 2011). Beside financial performance, non-financial performance, such as reputation (Ginesti, Caldarelli and Zampella, 2018), employee productivity (Sherif and Elsayed, 2016) and Malmquist productivity index (Alhassan and Asare, 2016; Oppong, Pattanayak and Irfan, 2019) also attract the researchers' interest.

Second category is impact on IC to other than firm performance variable, such as corporate governance (Shahzad et al., 2020) and corporate sustainability (Xu, Chen and Zhang, 2020). While the third category is study regarding the factors that drives IC, such as governance (Nadeem et al., 2017; Kweh et al., 2019; Dalwai and Mohammadi, 2020; Tran, Van and Vo, 2020). This finding is also confirmed by existence ownership structure variable on the result of VOS Viewer which is located far from the center as shown in Figure 5.

The most used control variables are firm size, leverage and firm age, although others are also included such as industry characteristic, risk and also crisis situations. IC is also used as mediating or moderating variable (Nadeem et al., 2017; Tiwari

and Vidyarthi, 2018; Kweh et al., 2019; Shahzad et al., 2020), as well as innovation (Amin and Aslam, 2017; Bayraktaroglu, Calisir and Baskak, 2019). However not many research has been address for this issues.

According to VOS Viewer result shown in Figure 6, several research in current year or 2020 used Generalized Method of Moment (GMM), data envelopment analysis (DEA) and capital employed efficiency (CEE). Research employed a dynamic panel data model – GMM to handle endogeneity problem in the model (Kehelwalatenna, 2016; Sherif and Elsayed, 2016; Nadeem et al., 2017; Anifowose et al., 2018; Smriti and Das, 2018; Yao et al., 2019; Nadeem, Dumay and Massaro, 2019; Oppong, Pattanayak and Irfan, 2019; Dalwai and Mohammadi, 2020; Tran and Vo, 2020; Tran, Van and Vo, 2020)Data envelopment analysis also appeared in the VOS Viewer result in measuring productive efficiency (Oppong, Pattanayak and Irfan, 2019; Ting et al., 2020).
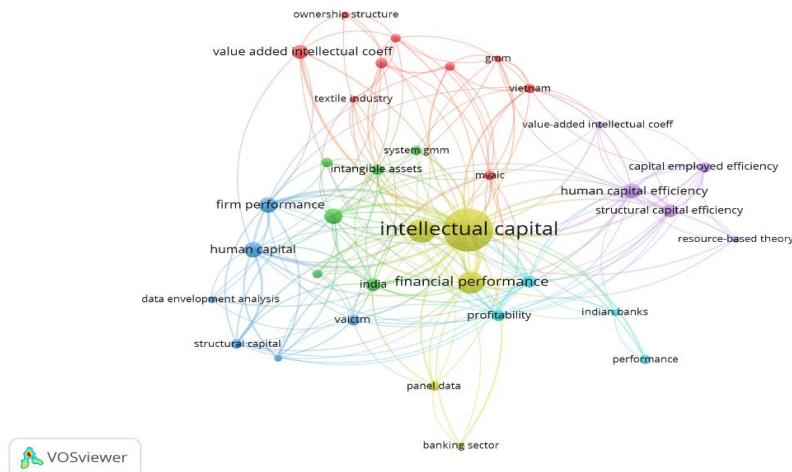

Figure 5. Network Visualization for Documents under Review

Among 50 most-cited articles under review, several articles state that the limitation of the research is the level of generalization for the research result (Alhassan and Asare, 2016; Meles et al., 2016), due to restriction of observation periods, type of industries and country scope. The use of VAIC as an IC measure is part of the limitation too (Iazzolino and Laise, 2016; Singh et al., 2016; Nawaz and Haniffa, 2017; Smriti and Das, 2017; Ginesti, Caldarelli and Zampella, 2018). This limitation is inherent with the weakness or critics of VAIC as one method to measure IC.

Practitioners and academics must be aware and pay

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attention to the impact on the critics of VAIC addressed recently because VAIC is an indicator of intellectual capital is misleading (Ståhle, Ståhle and Aho, 2011) and managers' decision making could be impaired (Marzo, 2021). Effort to overcome the inherent weaknesses of VAIC has been done by some researchers that propose or support to modify or adjust VAIC (Maji and Goswami, 2017; Nadeem et al., 2017; Ulum, Kharismawati and Syam, 2017; Tiwari and Vidyarthi, 2018; Mohammad and Bujang, 2019; Yao et al., 2019; Nadeem, Dumay and Massaro, 2019; Xu and Li, 2019; Selvam, Thanikachalam and Dhanasekar, 2020; Soewarno and Tjahjadi, 2020; Tran, Van and Vo, 2020)
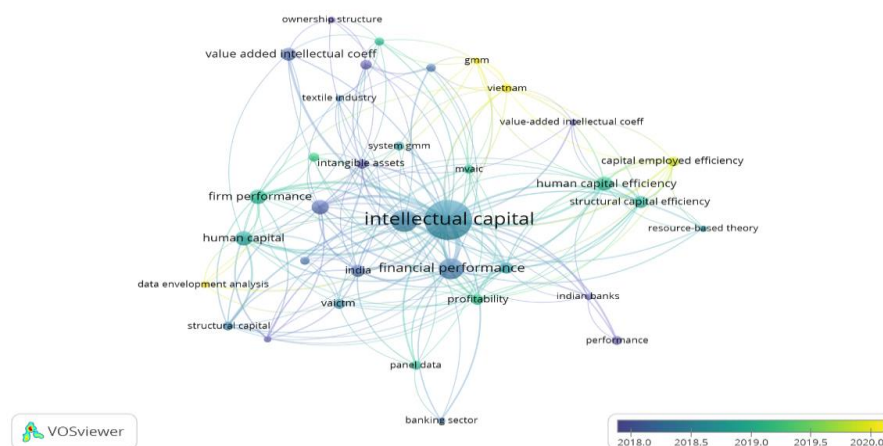

Figure 6. Overlay Visualization for Documents under Review

There are 11 out of 130 used in this study or only less than 10 % has already address the weakness of VAIC in their research. However, among 11 articles, there are 9 out of 50 articles under further review that discuss or use modified or adjusted VAIC in their research. Some of the modified-VAIC includes new determinant such as innovation, relational capital, etc as well as modifying the value added calculation, one of the most critical issues in VAIC measurement. After their publications in 2016-2020, all the papers discussing modified or adjusted VAIC have 176 citations or 20 citation per article in Scopus database only. It means, effort to do refinement or modified VAIC has already been being carried out and contributing more robust theory and model in IC literatures.

Conclusion

Despite of its weaknesses that has been addressed years before, VAIC is still the most popular method used in IC research, especially in the period under study. VAIC research on the the Scopus journals dominantly published in Q1 and Q2 ranks. Most journal international reputable articles are published under Emerald Group Publishing and two highly reputable international journals contribute significantly for the IC research. They are Journal of Intellectual Capital and International Journal of Learning and Intellectual Capital. The impact of the articles under review is quite high to the IC research as reflected by more than 1500 citations. There are 3 classifications of VAIC research. Most research focused on the first category which in the impact of IC toward firm performance represented by profitability and productivity, with ROA, ROE, ATO as the variables. Other research classifications are the link between IC and other factor, such as innovation and corporate governance and research classification that study about factors that drive VAIC.

Due to the justified critics, precaution must be taken by researchers when they draw conclusion on their studies, especially if the research uses original VAIC model. Research on VAIC is still relevant in the future, especially in modifying, reshaping or remodelling VAIC for it to become a robust model. Future research may be focused on the inclusion of other variables, such as innovation and relational capital as it might be the hidden factors for the inconsistency of VAIC. Impact of modified VAIC to financial and nonfinancial performance might be part of researchers' interest too. Another research avenue also open for the link of IC and corporate governance as well as sustainability issues, especially in the context of knowledge-based and green economy.

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