# Estimating Intellectual Capital and its Impact on Firms' Performance : Use of A-VAIC and M-VAIC Models

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## Abstract

**The study examined the contribution of intellectual capital to companies' overall performance. Also, a comparison between the effectiveness of the adjusted value-added intellectual coefficient (A-VAIC) and the modified value-added intellectual coefficient (M-VAIC) model for estimating IC components and analyzing their impact on firms' performance was attempted. The study was carried out for 405 Indian companies listed on the NSE-500 index for 10 years (2010–2011 to 2019–2020). It was found in the results that intellectual capital is indeed helpful in improving firms' financial and market performance. However, the M-VAIC is more detailed and precise. Hence, the IC components estimated using it can explain companies' performance more effectively than the A-VAIC.**

***Keywords :*** **intellectual capital, M-VAIC, A-VAIC, financial performance, market performance, India**

**JEL Classification Codes : C4, G32, M41, L1**

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The growth of knowledge, communication technology, and extreme global competition have led to the fast development of global business. Intellectual Capital (IC) or intangible assets, rather than tangible assets, are often recognized as more crucial drivers of business competitiveness and value creation in the knowledge economy (Jelínková & Jiřincová, 2015). However, it has long gone unnoticed since traditional accounting regulations limit the disclosure of intangible assets (excluding goodwill) on a company's balance sheets (Joshi et al., 2013; Wang & Chang, 2005). Only lately have researchers and academicians begun to investigate this area, realizing that IC is not merely a catalyst for a company's development but also helps organizations gain a competitive edge in the market. Thus, companies must pay more attention to knowledge or intellectual assets for sustainability and growth in the knowledge economy. Several companies are extensively knowledge-driven, such as IT, pharmaceutical, banking or financial services, and law, as they depend primarily on

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intellectuals for their performance. All organizations, therefore, need IC to operate in this knowledge economy and ensure sustainability. Greater dependence on these assets implies that companies would significantly maximize IC and increase it constantly.

IC is known as the "hidden capabilities" of a company (Edvinsson, 1997) or as "knowledge-based assets" that bring value to the company's growth in the competitive economy of today (Ordoñez de Pablos, 2005). Throughout the literature review, it has been observed that authors and researchers are inclined toward classifying IC instead of defining it. While the commonly recognized definition of IC is not yet identified, there is an awareness that intangibles contribute substantially to an organization's wealth. The present study considers IC as the summation of knowledge that an organization possesses from its humans, processes, innovations, and relations, as handled by the management to strengthen the competitive edge and enhance wealth. Many authors identify IC as the composition of two components, while others identify it as a sum of three or four components. Researchers argue that IC consists of Human Capital (HC) (summation of a person's intellect and expertise which the company uses to attain its long-term goals) and Structural Capital (SC) (non-human knowledge assets) (Bontis, 1998; Muhammad et al., 2008).

On the other hand, a few define IC as the combination of Human Capital, Relational Capital (RC) (knowledge that an organization obtains by maintaining relationships with stakeholders). Structural Capital or Organizational Capital is further divided into Innovation Capital (InC) and Process Capital (PC) (Anifowose et al., 2018; Bosworth & Rogers, 2001; Ghosh & Maji, 2015; Kamath, 2017). Here, InC is expected to comprise the development of new products that are focused on consumer needs, and PC includes techniques, procedures, and information systems, that build up the production system of goods and services.

Since the late 1980s, researchers have also started concentrating on the creation of an IC measuring model. The primary aim of the measurement models was to measure and regulate intangibles, and these models were subsequently extended to include IC. The most widely accepted model, i.e., Value Added Intellectual Coefficient (VAIC), was developed by Pulic (1998). It was the first model that used data collected from financial statements and the company's annual reports to calculate IC. The model measures the efficacy of IC across industries. As per the model, "the total value of the firm is the summation of Capital Employed (CE) used as a proxy of tangible capital, summation of HC and SC as a measurement of IC." However, the model was highly criticized on what exactly constitutes SC. As discussed in other models, it is the composition of renewal and development capital and process capital; therefore, researchers questioned this model. As a result, two significant efforts were made to redesign the original VAIC. First, in 2007, Nazari and Herrmans proposed the modified version of the original VAIC. The authors modified the model (M-VAIC) by dividing SC into RC, InC, and PC. Secondly, Nadeem et al. (2019) suggested adjusted VAIC (A-VAIC) wherein InC replaced SC.

Researchers have emphasized that IC is essential in improving a company's performance. The formation and productive utilization of these assets adds to the value of the firm and, thus, enhance the firm's performance (Chen Goh, 2005; Ghosh & Maji, 2015; Gupta & Raman, 2021; Hang Chan, 2009; Joshi et al., 2013; Nawaz, 2019). The present study is one of the first attempts to implement both A-VAIC and M-VAIC to measure firms' value. It offers insights into the IC performance of Indian companies listed on the National Stock Exchange (NSE)-500 from 2010 through 2020. The study outcomes will benefit the Indian companies' management in the structure and composition of IC.

## Background of the Study and Review of Literature

### *The Concept of Intellectual Capital*

J.K. Galbraith first described IC as part of value creation in 1969 (Galbraith, 1969). However, recently only, IC has

been accepted as a research subject. It gained momentum after an article by Stewart (1995) in *Fortune* magazine. The article measured IC as the learning capacity, ability, and knowledge of employees, which in turn, reinforces the organizations' competitive edge. Initially, the gap between a company's book value and market value was treated as IC (Edvinsson & Malone, 1997). As per Davenport and Prusak (1997), IC refers to technology, technological changes, and issues related to information technology management. An organization using technology to control and process data can use IC properly.

Various authors and researchers have advocated the meaning of IC by defining the components that sum up intellectual capital. While the components tend to have a similar base, there are differences in the terminology used and structure of these components. As discussed, a few researchers identify IC as the combination of HC and SC, while others recognize it as the sum of HC and divide SC into RC, InC, and PC. Also, various efforts have been made to calculate the efficiency of IC, but the most acceptable method for measurement of IC in academics and research areas is Pulic's (1998, 2000) Value Added Intellectual Coefficient (VAIC™). This model provides an organized and transparent base for measurement than other models (Firer & Mitchell Williams, 2003). The VAIC™ model comprises capital employed efficiency (CEE) (tangible capital), human capital efficiency (HCE), and structural capital efficiency (SCE). However, the composition of SCE given in Pulic's model was questioned by many authors (Chen et al., 2005; Maditinos et al., 2011). Hence, the model was modified by Nazari and Herremans (2007) by adding RCE, InCE, and PCE as new components of SCE. Additionally, a recent adjustment in the original VAIC model has been made by Nadeem et al. (2019). According to them, SC is merely a component that includes expenditure done on R&D; hence, they replaced SCE with InCE. These models gained immense recognition from researchers and academicians (Basuki & Kusumawardhani, 2012; Hang Chan, 2009; Kamath, 2017; Nimtrakoon, 2015; Soewarno & Tjahjadi, 2020).

## Components of Intellectual Capital

### *Human Capital*

HC is regarded as the summation of a person's intellect and expertise used by a company to attain its long-term goals. This capital provides businesses with the opportunity to make more money. It is not unexpected that HC is the highest contributing component, considering the significance of knowledge to IC. The capital includes the employee's expertise, knowledge, ability to innovate, competencies, and experience (Bontis, 2001; Roos et al., 1997).

### *Structural Capital*

SC consists of supporting structures that enable the company to access IC (Muhammad et al., 2008). An organization's structure is very vital. The structure stays even if an employee leaves the organization but grows as new employees add to the capital. It is the foundation of an organization that offers consistency. In developing SC, management plays the most crucial role. It consists of hierarchical structures, methods, schedules, frameworks, technologies, databases, and so on that stay within the company (Edvinsson & Malone, 1997; Ordoñez de Pablos, 2005).

### *Relational Capital*

RC is also known as customer capital. It is capital formed outside the organization and is mainly linked to the

market, boosting its capabilities. It shows relationships with the customers, industry, suppliers, society, government, and shareholders. It also constitutes a company's relationship with other companies (Capello & Faggian, 2005).

### *Innovation Capital*

Innovations result in more efficient production cycles and a higher return on investment for the firm. The result of innovation is the introduction of unique products, which give greater value to the customers. In addition, it offers better options for consumers than competitors in terms of quality, price, and rewards. Therefore, the company's expenditure on research and development is considered the InC (Bosworth & Rogers, 2001).

### *Process Capital*

Processes have evolved into a vital component of every company and a critical instrument for defining how assets are managed. It describes how a firm prepares its activities to achieve its goals. For processes to become PC, these processes must generate value from the productivity of the processes in an organization. It is a part of IC that encourages the development, accessibility, and sharing of knowledge (Anifowose et al., 2018).

### *Previous Studies*

Numerous studies have noticeably seen that IC is a significant indicator in determining firms' value and is considered a measure of worldwide financial and economic development (Bontis, 2001; Cabrita & Bontis, 2008). Firer and Mitchell Williams (2003) tested IC's impact on the traditional corporate performance measures for 75 publically traded South African companies. They failed to showcase a link between IC and ROA, a proxy to measure profitability. Using information from 11 Australian banks, Joshi et al. (2010) identified that all Australian-owned banks have comparatively greater effectiveness of HCE than CEE and SCE. The research shows that VAIC is essential to human expenditure and Australian banks' value creation. Using multiple regression, Vishnu and Kumar Gupta (2014) investigated the effect of IC and financial performance by adding RC to the original VAIC model. The outcomes indicated that RC is a crucial component of IC and should be a part of the model.

Ghosh and Maji (2015) validated the VAIC model and used panel data regression on 62 Indian companies to review its impact on ROA and MB. The research showed that VAIC could not be ignored as an intellectual capital measurement method. Aggregate IC has a substantial and positive impact on both dependent variables. In another study implementing Tobin's *Q* to estimate the firm's market value, Hejazi et al. (2016) explored 100 Iranian firms. The statistics promote the theory that HC and IC are closely linked to performance (Tobin's *Q*). Also, Wijaya et al. (2016) reviewed the relationship between IC and agency conflict in Indonesian companies, and the results showed that IC reduces agency conflict in a firm. Anifowose et al. (2018) researched 91 Nigerian companies of multiple sectors. The paper used Economic Value Added (EVA) and free cash flow as the explanatory variables to determine the company's valuation. The study used a modified VAIC model as a proxy to assess IC efficiency and showed that there is a strong and relevant association between IC and EVA and free cash flow. Relational capital, process capital, and innovation capital, components of M-VAIC, have a noticeable impact on EVA. Using the M-VAIC model for estimating IC, Thiagarajan et al. (2018) attempted to assess the association of IC with various aspects of firm performance. Based on the sample from the Indian auto component industry, the study confirmed that companies could improve their performance by focusing on their knowledge-based assets along with the traditional ones.

Recently, Xu and Wang (2019) studied VAIC and M-VAIC to evaluate the IC efficiency of 29 and 37 textile enterprises in China and South Korea, respectively. The findings suggested that IC significantly affects China and South Korea's productivity, profitability, and earnings. Kesse et al. (2019) studied the tourism and hospitality sectors of the Indian economy to examine the relationship between IC and the financial performance of companies. Using the VAIC model only, the study emphasized that human capital is the most influential component of IC. Gupta and Raman (2021) explored the impact of IC on the operational efficiency of Indian banks and found a strong association between efficiency and IC. Another recent study by Soewarno and Tjahjadi (2020) examined the relationship between IC and financial performance and compared VAIC and A-VAIC models for IC measurement. The results showed that new and deeper insight was gained after replacing SC with InC. Undertaking the case of government banks in India, Himanshu and Madhur (2020) estimated IC using the VAIC model. The study summarized that the sample banks could have performed better in maintaining knowledge-based assets.

### *Research Gap*

Many researchers have devised different models to estimate IC because of the significance of knowledge-based capital. However, these models focus on one or the other component of IC at a time only. In order to comprehensively determine the role of IC in improving firm performance, it is equally important to select the most efficient model for estimating IC first. Extensive literature is available focusing on how IC enhances the profitability of firms. However, not many studies have focused on the importance of IC estimation. Thus, the present work aims to fill this gap of grave importance by comparing the two most talked about models of IC estimation and analyzing the impact of IC on firm performance.

## Research Methodology

The present section sets forth the objectives, research model, variables, empirical models, and data source used for the research.

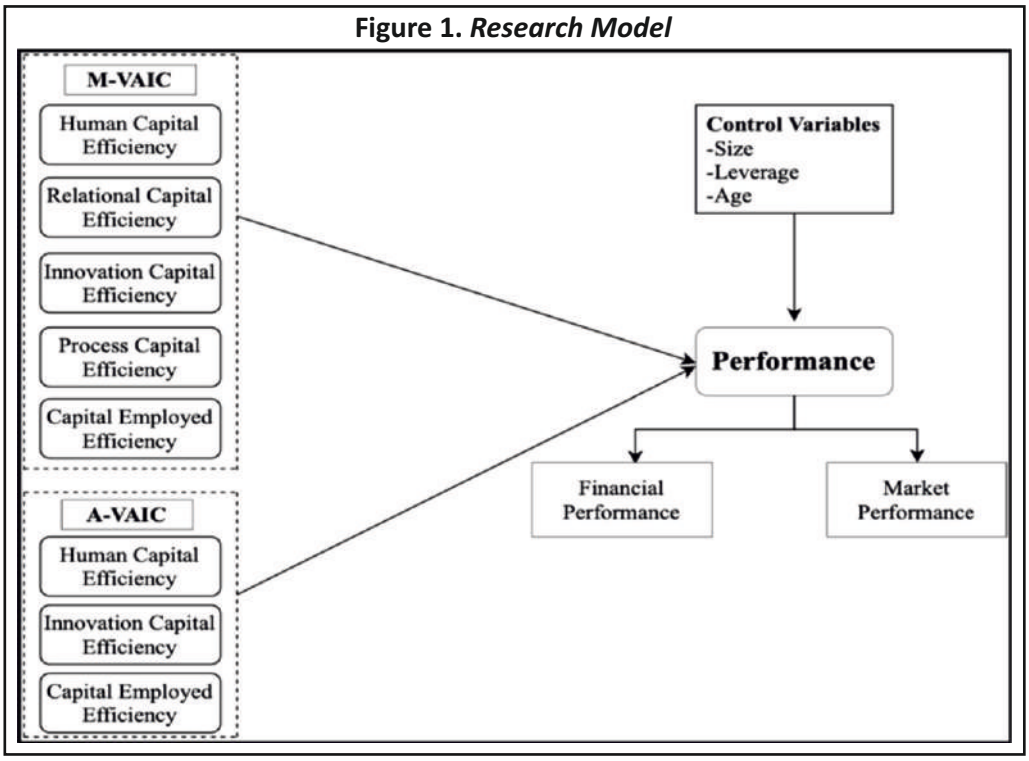
### *Objectives and Research Model*

The main aim of the paper is to explore the impact of components of IC on firms' performance. For this purpose, two separate models, M-VAIC and A-VAIC, have been used to represent IC to compare their effectiveness in measuring intellectual capital. The sub-objectives are as follows:

- To examine the impact of M-VAIC components on financial performance.
- To examine the impact of M-VAIC components on market performance.
- To examine the impact of A-VAIC components on financial performance.
- To examine the impact of A-VAIC components on market performance.

In order to achieve the aforementioned objectives of the paper, the research model has been framed (refer to Figure 1). The present study uses empirical research methods based on numerical data collected from secondary sources. Hence, it can be categorized as quantitative research. A longitudinal or panel data regression approach has been applied to deal with heterogeneity across time and cross-sectional units. Various diagnostic tests have been performed to select the appropriate model for regression analysis and examine if these models meet the

**Figure 1.** ***Research Model***




assumptions of multiple regression. The study has attempted to present a more detailed picture of firm performance by considering both financial and market performance. STATA 14.0 is the software used for data analysis in the present study.

Since the study has the objective to compare the effectiveness of M-VAIC and A-VAIC models in computing IC components and examining their impact on firms' performance, thus, two separate regression models have been used, as shown below:

**For M-VAIC :**

**Model 1 and Model 2**

$$Perf_{(i,t)} = \alpha + \beta_1 HCE_{M(i,t)} + \beta_2 PCE_{M(i,t)} + \beta_3 RCE_{M(i,t)} + \beta_4 InCE_{M(i,t)} + \beta_5 CEE_{M(i,t)} + \beta_6 Size_{(i,t)} + \beta_7 Leverage_{(i,t)} + \beta_8 Age_{(i,t)} + \varepsilon \quad \ldots\ldots\ldots\ldots (1)$$

**For A-VAIC :**

**Model 3 and Model 4**

$$Perf_{(i,t)} = \alpha + \beta_1 HCE_{A(i,t)} + \beta_2 InCE_{A(i,t)} + \beta_3 CEE_{A(i,t)} + \beta_4 Size_{(i,t)} + \beta_5 Leverage_{(i,t)} + \beta_6 Age_{(i,t)} + \varepsilon \quad \ldots\ldots\ldots (2)$$

where, *Perf* is proxied by *FinPerf* and *MktPerf*, the indices are estimated using principal component analysis. The factors included in these indices have been mentioned in the next section, along with the IC components and control variables. The subscript *i* represents the cross-sectional units, i.e., companies included in the sample, and

subscript *t* shows time series (2011, 2012, 2013……..2020). $\beta_1$, $\beta_2$,…… $\beta_8$ are the regression coefficients to be estimated. The hypotheses tested in the present study are shown in Table 1.

### *Variables*

This section discusses the variables and measurement model of IC used in the present study. The variables are categorized into dependent, independent, and control variables.

**Table 1.** ***Hypotheses Formulated***

| | Null Hypotheses ($H_0$) | Alternate Hypotheses ($H_a$) |
|---|---|---|
| **H1** | Human capital efficiency calculated using the M-VAIC model does not significantly impact financial performance. | Human capital efficiency calculated using the M-VAIC model significantly impacts financial performance. |
| **H2** | Human capital efficiency calculated using the M-VAIC model does not have a significant impact on market performance. | Human capital efficiency calculated using the M-VAIC model has a significant impact on market performance. |
| **H3** | Relational capital efficiency calculated using the M-VAIC model does not have a significant impact on financial performance. | Relational capital efficiency calculated using the M-VAIC model has a significant impact on financial performance. |
| **H4** | Relational capital efficiency calculated using the M-VAIC model does not have a significant impact on market performance. | Relational capital efficiency calculated using the M-VAIC model has a significant impact on market performance. |
| **H5** | Innovation capital efficiency calculated using the M-VAIC model does not have a significant impact on financial performance. | Innovation capital efficiency calculated using the M-VAIC model has a significant impact on financial performance. |
| **H6** | Innovation capital efficiency calculated using the M-VAIC model does not have a significant impact on market performance. | Innovation capital efficiency calculated using the M-VAIC model has a significant impact on market performance. |
| **H7** | Process capital efficiency calculated using the M-VAIC model does not have a significant impact on financial performance. | Process capital efficiency calculated using the M-VAIC model has a significant impact on financial performance. |
| **H8** | Process capital efficiency calculated using the M-VAIC model does not have a significant impact on market performance. | Process capital efficiency calculated using the M-VAIC model has a significant impact on market performance. |
| **H9** | Capital employed efficiency calculated using the M-VAIC model does not have a significant impact on financial performance. | Capital employed efficiency calculated using the M-VAIC model has a significant impact on financial performance. |
| **H10** | Capital employed efficiency calculated using the M-VAIC model does not have a significant impact on market performance. | Capital employed efficiency calculated using the M-VAIC model has a significant impact on market performance. |
| **H11** | Human capital efficiency calculated using the A-VAIC model does not have a significant impact on financial performance. | Human capital efficiency calculated using the A-VAIC model has a significant impact on financial performance. |
| **H12** | Human capital efficiency calculated using the A-VAIC model does not have a significant impact on market performance. | Human capital efficiency calculated using the A-VAIC model has a significant impact on market performance. |
| **H13** | Innovation capital efficiency calculated using the A-VAIC model does not have a significant impact on financial performance. | Innovation capital efficiency calculated using the A-VAIC model has a significant impact on financial performance. |
| **H14** | Innovation capital efficiency calculated using the A-VAIC model does not have a significant impact on market performance. | Innovation capital efficiency calculated using the A-VAIC model has a significant impact on market performance. |
| **H15** | Capital employed efficiency calculated using the A-VAIC model does not have a significant impact on financial performance. | Capital employed efficiency calculated using the A-VAIC model has a significant impact on financial performance. |
| **H16** | Capital employed efficiency calculated using the A-VAIC model does not have a significant impact on market performance. | Capital employed efficiency calculated using the A-VAIC model has a significant impact on market performance. |

### *Dependent Variables*

Financial profitability and market performance have been considered to present a comprehensive picture of firms' performance. Therefore, various ratios and indicators have been used to depict financial and market performance. However, in place of using these indicators as dependent variables individually in separate regression models, two indices have been computed using principal component analysis (PCA). The results of PCA have been explained in the Analysis and Results section.

For financial performance, the following ratios have been used:

- ***Return on Assets (ROA).*** It is a financial profitability indicator that shows companies' profit earned in comparison to their total assets. It indicates the company's ability to generate profits using the available resources.

- ***Return on Equity (ROE).*** It shows the profits earned by any company using the money raised by it from equity shareholders.

- ***Return on Capital Employed (ROCE).*** It evaluates the efficiency and profitability of the firm with respect to the amount of capital used. ROCE is a long-term profitability ratio that reveals how efficiently assets are operating when considering long-term financing.

The market performance index has been computed using the measures given below:

- ***Price-Earnings Ratio (P/E).*** It is the ratio of market price per share to the company's earnings per share. Investors and analysts generally use the P/E ratio to estimate the company's value in relative terms.

- ***Market to Book Value Ratio (M/B).*** It is the ratio that determines the firm's current market value in relation to its book value. Market value is obtained by multiplying the share price by the number of shares.

- **Tobin's *Q*.** It is also known as the *Q* ratio, which reflects the relation between the market value and replacement cost of assets. It is generally used to determine whether the company or industry is overvalued or undervalued in the market.

### *Independent Variables*

The study measured IC using Modified VAIC and Adjusted VAIC. Both models consist of different components that estimate the firm's value. As per the M-VAIC model by Nazari and Herrmans (2007), the value of the firm is the summation of human capital efficiency (HCE), structural capital efficiency (SCE), which is divided into relational capital efficiency (RCE), innovation capital efficiency (InCE), process capital efficiency (PCE), and capital employed efficiency (CEE). On the other hand, A-VAIC by Nadeem et al. (2019) is the aggregate of human capital efficiency, innovation capital efficiency, and capital employed efficiency. The calculation of these variables is presented in Table 2.

### *Control Variables*

The current research has also incorporated three control variables to control their effect on the performance of the companies. Firm size is calculated as the natural logarithm of total assets (Gupta & Raman, 2021; Kamath, 2017); leverage is determined as the ratio between total debt and the book value of total assets (Ghosh & Maji, 2015; Gupta & Raman, 2021). Lastly, age is computed as the difference between the incorporation year and the year of the study (Joshi et al., 2016).

**Table 2.** ***Calculation of Independent Variables***

| Independent Variables | Formula | |
|---|---|---|
| **M-VAIC** | **Human Capital Efficiency + Relational Capital Efficiency + Innovation Capital Efficiency + Process Capital Efficiency + Capital Employed Efficiency** | |
| Value Added$_M$ | Interest expenses + Depreciation + Dividend + Taxes + Minority Interest + Retained Earnings + Wages and Salaries | |
| Human Capital Efficiency$_M$ | Value Added$_M$/Human Capital | Human Capital = Employees' expenses |
| Relational Capital Efficiency$_M$ | Relational Capital/Value Added$_M$ | Relational Capital = Marketing and Advertising expenses |
| Innovation Capital Efficiency$_M$ | Innovation Capital/Value Added$_M$ | Innovation Capital = Research and Development expenses |
| Process Capital Efficiency$_M$ | Process Capital/Value Added$_M$ | Process Capital = Structural Capital – Relational Capital – Innovation Capital (Structural Capital = Value Added – Human Capital) |
| Capital Employed Efficiency$_M$ | Value Added$_M$/Capital Employed | Capital Employed = Book value of total assets |
| **A-VAIC** | **Human Capital Efficiency + Innovation Capital Efficiency + Capital Employed Efficiency** | |
| Value Added$_A$ | Net Income + Labor Cost + Interest expenses + Taxes + Depreciation + Research and Development | |
| Human Capital Efficiency$_A$ | Value Added$_A$/Human Capital | Human Capital = Employees' expenses |
| Innovation Capital Efficiency$_A$ | Value Added$_A$/Innovation Capital | Innovation Capital = R&D expenses |
| Capital Employed Efficiency$_A$ | Value Added$_A$/Capital Employed | Capital Employed = Book value of total assets |

### *Data Source and Sample Size*

The present study has used Standard & Poor's Capital IQ Database to collect data on all the listed companies on NSE-500. Indian economy is a globally competitive economy with more than 30 different sectors listed on Indian NSE. A multi-industry sample size enables the researcher to understand the inter-industry implication and expand the generalizations of the study (Bontis, 1998; Subramaniam & Youndt, 2005). Therefore, the study population comprises all listed companies on NSE-500 in the year 2020. In order to determine the final sample size, the study went through a data screening process, where raw data for all 501 companies listed on NSE-500 was collected, and screening was done thereafter. In the data screening, 96 companies were screened out because of the unavailability of data. The data was collected for 10 years (2010–2011 to 2019–2020). The final sample size determined is 405 companies having data for all 10 years.

## Analysis and Results

The primary objective of the present study is to examine the impact of knowledge-based intellectual capital on the performance of select companies. Following this objective, instead of focusing on the financial profitability of firms alone, the overall financial and market performance has been considered in this study. Also, in place of taking individual performance indicators like ROA, ROE, market-to-book value ratio, and others, PCA has been used to aggregate these measures. IC has been considered the chief determinant of performance, and for estimating its components, two different models, A-VAIC and M-VAIC, have been used. In this section, the results of the analysis and various tests have been presented and discussed.

### *Principal Component Analysis (Financial Performance and Market Performance)*

The dependent variable, firm performance, has been represented by two indices, i.e., FinPerf and MktPerf. The

**Table 3.** ***Principal Component Analysis Results for Financial and Market Performance Index***

| | Component 1 (Financial Performance) | | | Component 2 (Market Performance) | | |
|---|---|---|---|---|---|---|
| | Return on Assets | Return on Equity | Return on Capital Employed | Price-Earnings Ratio | Market to Book value ratio | Tobin's *Q* |
| Factor Loading | 0.6044 | 0.5059 | 0.6154 | 0.6064 | 0.5290 | 0.5937 |
| Eigen Value | | 2.268 | | | 2.35 | |
| Cumulative Variance Explained | | 0.7561 | | | 0.7833 | |
| Bartlett Test of Sphericity | | | | | | |
| Chi-square | | 6266.478 | | | 6667.065 | |
| *p*-value | | 0.000 | | | 0.000 | |
| KMO Measure of Sampling Adequacy | | 0.648 | | | 0.678 | |

reason for using an aggregated component in place of individual performance indicators is that it may cause duplication of results. Additionally, two separate comprehensive indices comprising financial profitability measures and market performance indicators can better present the picture of variation in firm performance. Previously, studies like Callahan et al. (2003), Ho and Wu (2009), and others have applied PCA to aggregate the attributes of individual factors into one index. Results of PCA have been reported in Table 3.

As mentioned in Table 3, for financial performance, ROA, ROE, and ROCE ratios have been taken under consideration. On the other hand, the P/E ratio, M/B ratio, and Tobin's *Q* represent the market performance of companies. The factor loadings are sufficiently high, and the individual factors positively correlate with the aggregated factors. The strength of a component for depicting variation in the original data is represented by Eigen Value. According to Kaiser (1960), components having Eigen Value higher than 1 need to be retained in the analysis. FinPerf and MktPerf meet the Eigen Value criteria of more than 1, as the Kaiser Rule requires. The aggregated component, FinPerf, explains 75.61% of the variation in ROA, ROE, and ROCE, whereas MktPerf has explained 78.33% of the variation in market performance indicators. In order to confirm the validity of the data for performing PCA, specific diagnostic tests have been conducted. Bartlett's sphericity test compares the correlation matrix between factors with the identity matrix to ensure a sufficiently high correlation (Bartlett, 1951). The null hypothesis indicating a lower correlation has been rejected by the results shown in Table 3. Hence, it implies that the individual factors correlate with each other, which is high enough for them to be aggregated into one component. The adequacy of the sample for applying PCA has been checked using Kaiser-Meyer-Olkin (KMO) test. The test statistics for KMO range from 0 to 1, and the rule of thumb states that the value above the minimum threshold of 0.50 indicates the adequacy of the sample. As mentioned in Table 3, the KMO value for both components is sufficiently high, thus implying the validity of the use of PCA.

### *Diagnostic Tests*

Certain preliminary diagnostic tests are to be conducted before performing regression analysis to select an appropriate approach for regression analysis and to examine if the proposed models have met the assumptions of regression. The results of these tests have been furnished in Table 4.

The regression models used in the present study are static; thus, the Hausman test is to be performed to check for the appropriateness of the fixed or random effect model (Hausman, 1978). The null hypothesis of this test favors adopting a random effect, whereas a fixed effect is to be applied if the null hypothesis is rejected. The results

**Table 4. *Diagnostic Tests***

| | M-VAIC | | | | A-VAIC | | | |
|---|---|---|---|---|---|---|---|---|
| | Model 1 Financial Performance | | Model 2 Market Performance | | Model 3 Financial Performance | | Model 4 Market Performance | |
| Hausman Test | $Chi^2$ | 100.97 | $Chi^2$ | 181.72 | $Chi^2$ | 38.46 | $Chi^2$ | 15.32 |
| (Fixed or Random Effect) | *p*-value | 0.0000 | *p*-value | 0.0000 | *p*-value | 0.0000 | *p*-value | 0.0179 |
| Modified Wald Test | $Chi^2$ | 528.51 | $Chi^2$ | 288.43 | $Chi^2$ | 587.69 | $Chi^2$ | 249.36 |
| (Heteroskedasticity) | *p*-value | 0.0000 | *p*-value | 0.0000 | *p*-value | 0.0000 | *p*-value | 0.0000 |
| Wooldridge Test | *F* | 34.462 | *F* | 51.222 | *F* | 34.101 | *F* | 49.637 |
| (Serial Correlation) | Prob > *F* | 0.0000 | Prob > *F* | 0.0000 | Prob > *F* | 0.0000 | Prob > *F* | 0.0000 |

reported in Table 4 indicate that the fixed effect model is to be opted for all the regression models. Thereafter, a vital assumption of multiple regression, namely, homoskedasticity, is to be checked. The absence of homoskedasticity implies that the disturbances do not have constant variance, also known as heteroskedasticity. Since fixed effect models are found to be apt for regression, a modified Wald test has been conducted to examine the presence of heteroskedasticity. The Chi2 test statistic has rejected the null hypothesis at a 1% significance level, implying that the error terms in regression models are heteroskedastic. The Wooldridge test has been used to examine whether the error terms are serially correlated (Wooldridge, 2015). The rejection of the null hypothesis in the results indicates that the disturbances are indeed autocorrelated. In the presence of heteroskedastic and serially correlated error terms, robust standard errors are to be used.

In order to check for the stationarity of the variables, the Levin-Lin-Chu test has been applied (Levin et al., 2002). All the dependent and independent variables are stationary at a 1% significance level. Variation inflation factor (VIF) has been calculated to see if any of the explanatory variables have multicollinearity. The VIF score for all the independent variables was less than the threshold of 10, as advised by O'Brien (2007), implying the absence of multicollinearity.

### *Regression Results*

In order to examine the impact of IC on the performance of select companies, the present study has calculated IC using two different models. The use of A-VAIC and M-VAIC has been done to compare their effectiveness in estimating IC and the ability of the models' components to explain firm performance. In addition, the study has attempted to present a complete picture of companies' performance by considering comprehensive financial and market standing indices. Following the results of diagnostic tests, the fixed effect model has been used for all the regression models. Also, since the error terms were heteroskedastic and autocorrelated, robust standard errors have been reported in the results.

Table 5 shows the regression results for the impact of the M-VAIC model's components on financial (FinPerf) and market (MktPerf) performance.

The significance of *F* statistics in Model 1 and Model 2 implies that the explanatory variables have a significant joint impact on both performance indicators. Also, the results show that M-VAIC components can explain 20.35% of financial performance and 36.90% of market performance. All the individual components bear a significant influence of similar nature over FinPerf and MktPerf. However, the magnitude of this impact differs between the two dependent variables. In both models, it was seen that firms' age does not substantially impact their performance. It implies that the old firms cannot use their experience to their advantage, and the more

**Table 5.** ***Regression Results (M-VAIC)***

| | Model 1 (Dependent Variable : Financial Performance) | | | Model 2 (Dependent Variable : Market Performance) | | |
|---|---|---|---|---|---|---|
| | **Coefficient** | **Robust Standard Error** | ***t*-value** | **Coefficient** | **Robust Standard Error** | ***t*-value** |
| Human Capital Efficiency$_M$ | 0.6877* | 0.1728 | 3.98 | 0.4119* | 0.0767 | 5.37 |
| Process Capital Efficiency$_M$ | 0.6269* | 0.1713 | 3.65 | 0.8793* | 0.1664 | 5.28 |
| Relational Capital Efficiency$_M$ | 0.8658* | 0.2829 | 3.06 | 1.7570* | 0.2738 | 6.42 |
| Innovation Capital Efficiency$_M$ | 0.0658* | 0.0265 | 2.48 | 0.9150** | 0.4494 | 2.04 |
| Capital Employed Efficiency$_M$ | 3.4233* | 0.3788 | 9.04 | 1.8931* | 0.3665 | 5.16 |
| Size | 0.3666* | 0.0309 | 11.86 | 0.1088* | 0.0299 | 3.64 |
| Leverage | –0.0046* | 0.0014 | –3.27 | 0.1225* | 0.0393 | 3.11 |
| Age | –0.0386 | 0.0406 | –0.95 | 0.0014 | 0.0013 | 1.04 |
| Constant | 0.0065 | 0.0166 | 0.39 | 0.0298*** | 0.0161 | 1.86 |
| *R*-Square | | 0.2035 | | | 0.369 | |
| *F* | | 25.95 | | | 41.19 | |
| Prob > *F* | | 0.0000 | | | 0.0000 | |

***Note.*** * Significant at 1% ; ** Significant at 5%.

contemporary companies are performing equally well. It can be due to the reason that new-age companies are stressing more on knowledge-based assets compared to traditional assets.

The results found that $HCE_M$ bears a positively significant impact on FinPerf and MktPerf as well. It implies that by focusing on employees' development by providing them with training and working on their knowledge growth, companies can improve their financial profitability and enhance their market standing. As suggested by Soewarno and Tjahjadi (2020), the efficiency of human resources can help reduce operating costs, which in turn contributes to increased profits. Apart from human capital, $PCE_M$ is expected to add substantially to firms' financial and market performance. It indicates that companies investing more in sophisticated processes and infrastructure, and paying attention to formulating a progressive policy framework, can generate higher performance and gain an edge over their competitors. Relational or customer capital is found to be having a significant positive impact on firms' overall performance. It can be inferred that by maintaining strong relations with customers and other stakeholders, the companies can ensure growth in the long run. In order to sustain itself in the market, a business must stay updated with technological changes and adapt to those changes. It can only be done if the companies work on new opportunities by researching new fields and developing strategies accordingly. The regression results depicted the same, finding that $InCE_M$ is positively and significantly associated with FinPerf and MktPerf. It implies that companies can expect a higher performance by focusing and incurring expenditure on research and development.

The tangible capital ($CEE_M$) has retained its importance. It can be seen in the results that the capital employed still bear a substantial impact on the performance of firms. Thus, company management should focus on knowledge-based assets; however, attention should not be diverted from traditional assets. The effectiveness and efficiency of tangible assets are still essential for the growth of businesses. Control variables, size, and leverage significantly impact both FinPerf and MktPerf. However, on the one hand, financial profitability is expected to improve with increased leverage, whereas more use of debt is expected to bring the market performance down.

The overall results are in line with Basuki and Kusumawardhani (2012), Ghosh and Maji (2015), Nimtrakoon (2015), Kamath (2017), Anifowose et al. (2018), Xu and Wang (2019), and others.

**Table 6.** ***Regression Results (A-VAIC)***

| | Model 3 (Dependent Variable : Financial Performance) | | | Model 4 (Dependent Variable : Market Performance) | | |
|---|---|---|---|---|---|---|
| | **Coefficient** | **Robust Standard Error** | ***t*-value** | **Coefficient** | **Robust Standard Error** | ***t*-value** |
| Human Capital Efficiency$_A$ | 0.0789* | 0.0171 | 4.61 | 0.0831* | 0.0166 | 5.00 |
| Innovation Capital Efficiency$_A$ | 0.1581 | 0.4449 | 0.36 | –0.2949 | 0.4322 | –0.68 |
| Capital Employed Efficiency$_A$ | 3.9387* | 0.3406 | 11.56 | 0.8604* | 0.3309 | 2.60 |
| Size | 0.3649* | 0.0305 | 11.96 | 0.0874* | 0.0296 | 2.95 |
| Leverage | 0.0703* | 0.0127 | 5.35 | 0.0046* | 0.0012 | 3.79 |
| Age | –0.0403 | 0.0407 | –0.99 | 0.1309* | 0.0395 | 3.31 |
| Constant | 0.0409 | 0.1655 | 0.24 | 0.0386** | 0.0161 | 2.40 |
| *R*-Square | | 0.1918 | | | 0.0881 | |
| *F* | | 32.26 | | | 7.68 | |
| Prob > *F* | | 0.0000 | | | 0.0000 | |

***Note.*** * Significant at 1% ; ** Significant at 5%.

**Table 7.** ***Summary of Hypotheses Testing***

| Null Hypotheses | IC Estimation Model | Dependent Variable | Independent Variable | Result |
|---|---|---|---|---|
| $H_0$1 | MVAIC | Financial Performance | Human Capital Efficiency | Rejected |
| $H_0$2 | | Market Performance | Human Capital Efficiency | Rejected |
| $H_0$3 | | Financial Performance | Relational Capital Efficiency | Rejected |
| $H_0$4 | | Market Performance | Relational Capital Efficiency | Rejected |
| $H_0$5 | | Financial Performance | Innovation Capital Efficiency | Rejected |
| $H_0$6 | | Market Performance | Innovation Capital Efficiency | Rejected |
| $H_0$7 | | Financial Performance | Process Capital Efficiency | Rejected |
| $H_0$8 | | Market Performance | Process Capital Efficiency | Rejected |
| $H_0$9 | | Financial Performance | Capital Employed Efficiency | Rejected |
| $H_0$10 | | Market Performance | Capital Employed Efficiency | Rejected |
| $H_0$11 | AVAIC | Financial Performance | Human Capital Efficiency | Rejected |
| $H_0$12 | | Market Performance | Human Capital Efficiency | Rejected |
| $H_0$13 | | Financial Performance | Innovation Capital Efficiency | Not Rejected |
| $H_0$14 | | Market Performance | Innovation Capital Efficiency | Not Rejected |
| $H_0$15 | | Financial Performance | Capital Employed Efficiency | Rejected |
| $H_0$16 | | Market Performance | Capital Employed Efficiency | Rejected |

The results for the impact of IC components, computed using A-VAIC, on firms' performance have been tabulated in Table 6. The regression estimates of the A-VAIC model are majorly consistent with M-VAIC. However, here it was found that the explanatory power, as indicated by *R*-square, of Model 3 and Model 4 is less than the previous models, i.e., Model 1 and 2.

Among the IC components, $HCE_A$ and $CEE_A$ significantly influence FinPerf and MktPerf. The results reported support the conclusion drawn by Soewarno and Tjahjadi (2020). Contrary to the results reported for M-VAIC models, $InCE_A$ is insignificant for firms' performance. It implies that, per A-VAIC estimation, expenditure incurred on R&D does not substantially benefit companies' performance. These results confirm Vishnu and Kumar Gupta (2014) and Bayraktaroglu et al. (2019). The results of the hypotheses testing have been summarized in Table 7.

## Conclusion and Implications

For the present economy, profit is not the only scale to measure a company's success. In addition to profit, it is now essential for the management to consider creating value for shareholders and setting up strategies for the company to survive in the dynamic business scenario. To a great extent, this depends on the investment in research and development, marketing and advertising, training and development of the employees, networking, and information systems. This is where IC comes into the picture, as it consists of all the aforementioned elements. IC is ranked as a powerful component in today's knowledge-based economy. The present study has been carried out in the light of Indian companies, and the impact of IC components has been studied on financial and market performance. The literature review showed mixed results regarding the relationship that IC and its components have with a company's performance. However, current research indicates that overall IC and performance (financial and market) have a positive relation. All the components of IC also have a positive and significant impact on both the performance measures. The outcome indicates that IC plays a vital role in increasing the performance of Indian companies. Companies must invest in HC, RC, InC, and PC to enhance the firms' performance and gain a competitive edge in the market. Additionally, tangible or physical or financial capital continues to act as essential for Indian companies to improve their financial position in the industry.

Comparing the two models of IC estimation, A-VAIC and M-VAIC, this study summarized that the M-VAIC model is more detailed and precise as it considers innovation capital and the process and customer/relational capital while computing structural capital. On the other hand, the A-VAIC model is entirely silent on the treatment and importance of efficient processes, policy frameworks, and stakeholder relations. In addition, the present study has found that the IC components calculated using A-VAIC are not able to explain the firms' performance as much as the M-VAIC can. Thus, it can be stated that M-VAIC has the edge over A-VAIC in the computation of IC and its components.

### *Implications*

The study's findings emphasized the importance of measuring IC in enhancing the company's performance. India, being a developing country, has immense IC potential. The importance of various aspects of IC that are to be extracted from this research opens up the opportunity for strategic approaches. It reveals the correct path for efficient and suitable management of resources. Management can choose to invest in a particular IC component, as organizations are experiencing scarce resources.

Consequently, management can attempt to select and invest in the most effective aspect of IC to increase the performance of the firms. Also, the organizations can benefit from obtaining more insights into the development

and administration of IC and learning which component, in particular, can help promote the management of the fundamental strategic resources of the company, thus ultimately improving the contribution of IC to the performance of the company. Additionally, organizations are encouraged to improve SC, i.e., adopting new and advanced technologies, higher investment in research and development, and additional obtainment of patents, trademarks, and copyrights that can lead to an increase in the overall performance and enhance the company's reputation in the eyes of customers.

## Limitations of the Study and Scope for Future Research

The study has some shortcomings that leave room for future search. However, limitations should not be used to undermine the significance of the research findings. For example, the study is only concentrated on Indian companies; cross-country analysis can help understand the efficiency of IC across nations. Another limitation is that the impact of IC is only studied on financial and market performance; however, the impact on corporate governance and productivity will give a more comprehensive picture of the management of IC in Indian companies.

## Authors' Contribution

Dr. Kanishka Gupta conceived the idea for this research paper and did the literature review. After discussing the variables and the data to be collected with the other authors, she collected all the data. Dr. Prakash Bhatia shaped the problem statement and supervised the whole study. Dr. Dolly Gaur performed the statistical analysis of the data collected and tabulated all the results. In addition, she contributed to interpreting and describing the results. The statistical analysis was done using STATA 14.0. Finally, Dr. Kanishka Gupta wrote the manuscript in consultation with the other authors.

## Conflict of Interest

The authors certify that they have no affiliations with or involvement in any organization or entity with any financial or non-financial interest in the subject matter or materials discussed in this manuscript.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