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Intellectual capital and performance of pharmaceutical firms in India

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Abstract

Purpose – The purpose of this paper is to study the relationship between intellectual capital (IC) and performance of pharmaceutical firms in India. The secondary objective is to propose and test modified models of Value Added Intellectual Coefficient (VAIC™) method.

Design/methodology/approach – Data on 22 large pharmaceutical firms collected for empirical investigation. Return on assets and return on sales are performance variables. IC and its components – human capital, structural capital and relational capital (RC), are predictor variables. Three extended and modified VAIC™ models (e-VAIC™) are proposed. Multiple regression technique is applied on pooled data to draw inferences.

Findings – Results show instances of positive relationship between IC and performance variables. RC, the new variable, does not demonstrate statistically significant relationship with performance variables.

Research limitations/implications – Due to inadequate reporting of IC and its components, availability of data on various proxies is difficult. The new models proposed in this paper can be a template for future research and model development.

Practical implications – VAIC™ model, the proposed models (e-VAIC™) and the result analysis can be useful for evaluation and value creation purposes.

Originality/value – Previous researchers use original VAIC™ model. This paper modifies and extends the model in accordance with contemporary description and typology of IC. Inclusion of RC as a variable in VAIC™ model and use of new proxies for components of IC are the novelties of this paper.

Keywords Performance, Intellectual capital, Relational capital, Pharmaceutical sector, Return on assets, VAIC™

Paper type Research paper

1. Introduction

Progressive perceptual advancement in studies on economy has reached a stage where it demands monographic change in accounting and valuation systems of business entities. With the emergence of knowledge-based organizations, the factor of productivity and value creation has shifted from tangible inputs (capital, plant and machinery) to knowledge workers who are professionally qualified and technically proficient. Here, the predominant source of value generation is the human mind – its tacit and explicit manifestations.

It is common observation that market value of stocks of many companies is higher than the replacement cost of their tangible assets (Sveiby, 1997b; Dumay, 2009). A plausible reason for this overvaluation is existence of a class of assets, intellectual capital (IC) (Brennan and Connell, 2000), in organizations which is not reflected in their

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accounting report. In germane literature, terms such as IC, intangible assets, invisible resources, intellectual property (IP), etc. have been interchangeably used by scholars.

The existent literature suggests that the relative significance of intangible assets such as human capital (HC), customer relations, brand name, corporate reputation, IP, organizational processes, innovation and patents has increased in knowledge economy. For almost two decades now, IC is occupying prominent position in economic wealth creation of firms. Hence, it is appropriate for organizations to measure and manage their IC for sustained competitive advantage (Bhartesh and Bandyopadhyay, 2005).

This paper evaluates IC–linked performance of large pharmaceutical firms in India. Intrinsically, pharmaceutical industry distinguishes itself with its knowledge-intensive features. It is considered innovative and research-oriented industry with due emphasis on quality of HC, R&D activities, product and process innovation and intellectual proprietorship. All these features make this industry an attractive proposition for research on IC. The pharmaceutical industry in India exhibits similar characteristics with commendable progress in basic infrastructure, range of products and technological advancement. Aspects such as implementation of good manufacturing practices, development of low cost technologies coupled with high quality products remain the major strengths of this industry. Today, an ever increasing number of pharmaceutical firms are in process of seeking drug approvals from regulatory authorities of foreign countries. All these advancements have propelled Indian pharmaceutical industry into the league of top generic pharmaceutical players in world.

Measurement of IC is essential for its management and reporting. Theorists and practitioners have proposed multiple models to measure IC and its components. Sveiby (2010) presents a compilation of 42 such models classified into four broad categories – direct intellectual capital (DIC) methods; market capitalization methods (MCM); return on assets (ROA) methods; and, scorecard (SC) methods. Amongst these, the MCM and ROA methods require aggregate inputs and measure IC at organizational level. In comparison, the DIC and SC methods use individual (component-wise) inputs for finer valuation of IC.

A popular ROA method for studying the impact of IC on corporate performance is the Value Added Intellectual Coefficient (VAIC™) model. This model was postulated by Ante Pulic in 1993 (Pulic, 2004). It measures efficiencies of IC and physical and financial capitals of a firm. More specifically, it assesses human capital efficiency (HCE), structural capital efficiency (SCE) and efficiency of capital employed (CE). Computation of VAIC™ is based on publicly available data which makes it relatively easy to use. It leads to quantitative and standardized measurement, thereby facilitating cross-sectional analysis. This is an objective method requiring no subjective grading or judgement or weightage (Abdulsalam *et al.*, 2011). The VAIC™ model forms the basis of empirical investigations of this study.

The primary objective of this paper is to measure IC of the selected pharmaceutical firms and study its impact on their performance. To meet this objective, three extended and modified variants of VAIC™ model (Pulic, 2004) have been proposed and tested. Consequently, investigation of the new models developed to measure IC is the secondary objective of this paper.

Ante Pulic's VAIC™ model measures efficiencies of HC, structural capital (SC) and CE. Although celebrated, VAIC™ has been criticized by Ståhle *et al.* (2011) for theoretical inconsistencies and non-inclusion of relational capital (RC) in the model. In this study, in sync with the contemporary classification and description of IC, VAIC™ model has been modified and expanded to accommodate all the three components

of IC – HC, SC and RC. The present work conceptualizes and investigates two efficiency-based models and one intensity-based variant of VAIC™. Since most of the previous researchers have used VAIC™ model in its original form (e.g. Mavridis, 2005; Kujansivu, and Lönnqvist, 2007; Tan *et al.*, 2007; Gan and Saleh, 2008; Abdulsalam *et al.*, 2011; Clarke *et al.*, 2011; Maditinos *et al.*, 2011; Mehralian *et al.*, 2012 and many Indian authors), this study is advancement over their work. For academicians and research scholars, this study opens up avenues for development of newer models for measuring IC. The practising managers and external stakeholders may use the models proposed in this paper to estimate IC of their firms.

The organization of this research paper is as follows – Section 2 reviews literature on IC and its linkage with performance of firms in pharmaceutical sector. Relevant research in India has also been discussed. Next sub-section identifies the research gap and proposes research hypotheses. Section 3 primarily reflects upon the research paradigm and methodology, data sample, dependent and independent variables and regression equations. VAIC™ model and the proposed models have also been described in this section. Results and ensuing discussions are the part of Section 4. Finally, Section 5 concludes the study.

2. Conceptual framework and hypotheses

2.1 IC – a primer

IC is an evolving field of research and it remains ambiguous as to what constitutes or describes IC. There is problem of plurality in definition of IC. Research scholars such as Edvinsson and Sullivan (1996), Stewart (1997) (cited in Ruckdeschel, 1998) and Bontis *et al.* (1999) have described IC as something related with knowledge, wealth creation and intangibility. The definition of IC adopted in this paper is – "Intellectual capital is the sum of the 'hidden' assets of the company not fully captured on the balance sheet, and thus includes both what is in the heads of organizational members, and what is left in the company when they leave" (Roos and Roos, 1997). This definition subtly indicates towards the explicit and tacit elements of IC.

Congruent to definition, classification of IC also lacks general agreement among the theorists. Multiple components of IC have been identified by researchers such as Brooking (1996), Edvinsson and Sullivan (1996), Sveiby (1997b) and Edvinsson and Malone (1997). However, the typology given by Seetharaman *et al.* (2004) has been used in this paper. They sub-divide IC into three components – HC, SC and RC. This is the predominant classification and is consistent with other taxonomies wherein similar aspects of IC have been classified under different titles. Some authors have used the term "customer capital" in lieu of "RC". Intuitively it is preferable to use "RC" because it encompasses a wider range of relationships.

2.2 IC and organizational performance

Research studies have been conducted across industries and geographical boundaries to study the impact of IC on business performance. Commonly, preferred industries are banking and finance (Mavridis, 2004; Young *et al.*, 2009; Bharathi, 2010; Joshi *et al.*, 2010, 2013; Kamath, 2010; Abdulsalam *et al.*, 2011; Gigante and Previati, 2011), information technology (IT) (Shiu, 2006; Gan and Saleh, 2008; Saleh *et al.*, 2009; Zéghal and Maaloul, 2010; Chang and Hsieh, 2011) and pharmaceuticals (Kamath, 2008; Mehralian *et al.*, 2012; Pal and Soriya, 2012). The research work on IC and firm performance covers varied geographical regions including Australia, Canada, Greece, India, Iran, Japan, Malaysia, the Netherlands, Pakistan, Taiwan, UK and USA.

Review of extent literature on IC and organizational performance reports mixed results. Some studies have found positive relationship between IC and organizational performance (e.g. Gan and Saleh, 2008; Young *et al.*, 2009; Clarke *et al.*, 2011; Mehralian *et al.*, 2012; etc.). Yet others have reported negative or weak relationship between the two variables (Firer and Williams, 2003; Zéghal and Maaloul, 2010; Abdulsalam *et al.*, 2011; Gruian, 2011).

2.3 IC, organizational performance and pharmaceutical sector

Due to its knowledge-intensive characteristics, pharmaceutical industry is amenable for research on IC. For assessment of IC, questionnaire survey and accounting data-based methods are used. Mehralian *et al.* (2012) have studied the impact of IC on performance of pharmaceutical industry in Iran. The authors apply VAIC™ model and report that components of IC have positive relation with just one performance variable – ROA. Further, they find that the major factor influencing organizational performance is physical capital and not IC. Hence, the study fails to establish positive link between IC and performance. Kamath (2008) has used VAIC™ model to conducted research on Indian pharmaceutical sector. The author concludes that there is insignificant impact of VAIC™ on performance of firms.

In comparison, the study by Sharabati *et al.* (2010) on Jordanian pharmaceutical sector concludes that the effective management of IC by managers has resulted in positive performance. On a similar note, a research by Bollen *et al.* (2005) on managers of German pharmaceutical firms has revealed that components of IC have positive influence on performance of firms. Based on their findings, the authors advocate inclusion of IP in the models designed for studying IC and performance. Research by Chen *et al.* (2010) on the US healthcare industry establishes positive and significant relationship between IC and performance of firms. In Indian milieu, the studies by Pal and Soriya (2012) and Ghosh and Mondal (2009) have yielded inconclusive results. Both the works report positive relation between IC and profitability (ROA) of a firm. However, the same is not significant in case of IC and productivity (asset turnover ratio) as well as IC and market valuation (market-to-book value).

2.4 IC and research in India

Research on IC is relatively new phenomena in India. Scholars have covered topics such as knowledge management (Thaker, 2001; Swamy, 2004), HC management (Choudhury and Mishra, 2010), strategic environment and IC (Deol, 2009), innovation management (Narvekar and Jain, 2006), measurement of IC (Kannan and Aulbur, 2004; Bhartesh and Bandyopadhyay, 2005; Jhunjhunwala, 2009), IC reporting and disclosure (Kamath, 2008; Bhasin, 2011; Singh and Kansal, 2011) and IC and performance (Kamath, 2007, 2008, 2010; Ghosh and Mondal, 2009; Choudhury, 2010; Murale, 2010; Pal and Soriya, 2012). Most of the researchers have used VAIC™ model. Industries covered are – IT, banking and textile and pharmaceuticals. In congruence to the studies conducted world over, researches in Indian context also yield mixed results on VAIC™ and organizational performance.

2.5 Research hypotheses

As evident from the preceding paragraphs, the extent and extant literature on IC and performance reports disputable results. Both, positive and negative linkages have been found between the two constructs. Concurrent to the global results, studies in India have also reported mixed findings. Moreover, the phenomenon of inconclusive result has been reported at the aggregate level (IC of a firm) as well at the component level of IC.

The primary objective of this paper is to measure IC of large pharmaceutical firms in India and to study its impact on their performance. VAIC™ model of Ante Pulic (2004) is the underpinning. However, since VAIC™ model evaluates only the HC and SC components of IC, it has been modified and extended to incorporate RC as well. Testing of these new models is the secondary objective of this paper. To sum it up, this research paper attempts to measure IC of large pharmaceutical firms in India and study its impact on their performance with the help of three new models being developed and tested in this paper. To address the two research objectives, three testable hypotheses have been developed. The first hypothesis specifically endeavours to understand the impact of IC on performance of pharmaceutical firms in India:

H1. IC of pharmaceutical firms in India is positively related to their performance.

In view of inconclusive results; both, at firm and component level of IC, further investigation is necessitated. Thus the second hypothesis is proposed:

H2. The components of IC are positively linked to the performance of pharmaceutical firms in India.

Modified and expanded variations of VAIC™ model are being proposed and empirically tested in the study. It is well tuned to prevailing classification of IC and cognizant of the criticism of VAIC™. Specifically it is found that addition of new variables to VAIC™ model improves its explanatory power (Clarke *et al.*, 2011; Chang and Hsieh, 2011). Based on this logic, the modified and expanded models explore how efficiency of IC, including RC, affects performance. To address the secondary objective; it is proposed to compare the expounding power of various models. The corresponding hypothesis is:

H3. The extended and modified VAIC™ models proposed in this study are a better predictor of IC and performance of a firm in comparison to the VAIC™ model.

3. Research methodology

For addressing the three hypotheses stated in the previous Section 2.5, positivism (also referred to as naive realism) is being adopted as the research paradigm in this paper. According to Wahyuni (2012), research paradigm describes the philosophical outline of the subject being studied and has implications for research design and methodology of the study. The positivist approach being applied in this paper shall lead to deductive inferences (for hypotheses testing), reproducibility of this study and generalization of results. Crossan (2003) enunciates that positivism invariably employs quantitative research methods for investigating the causal relationships. Accordingly, this research is an empirical study wherein quantitative secondary data on 22 large pharmaceutical firms in India has been used. These firms are into bulk drugs production and formulation. The sample data were obtained from "Capitaline" database and Annual reports of the companies. The time period of data sample extends from 2005 through 2011. Only those firms have been selected which meet the criterion of availability of continuous data. For testing the stated hypotheses, OLS regression was applied on the pooled data which was then processed on SPSS18 to determine the strength of relationships among the variables. A brief deliberation on the VAIC™ model and the proposed models (extended and modified versions of VAIC™) precedes hypothesis testing.

3.1 The VAIC™ model

The VAIC™ model evaluates the efficiency of IC and uses the concept of value added (VA) as success parameter of business. Pulic develops an equation to incorporate the elements of HC and SC along with financial and physical capital, i.e. CE. The final equation developed by Pulic is:

$$\text{VAIC™} = \text{ICE} + \text{CEE} \tag{1}$$

where, VAIC™ is the Value Added Intellectual Coefficient; ICE the intellectual capital efficiency coefficient; CEE the capital employed efficiency coefficient.

Since ICE is composed of efficiencies of HC and SC:

$$\text{ICE} = \text{HCE} + \text{SCE} \tag{2}$$

Therefore, on incorporating Equation (2) in Equation (1) we get:

$$\text{VAIC™} = \text{HCE} + \text{SCE} + \text{CEE} \tag{3}$$

According to Pulic (2004), the computation of these variables is done as follows (Figure 1):

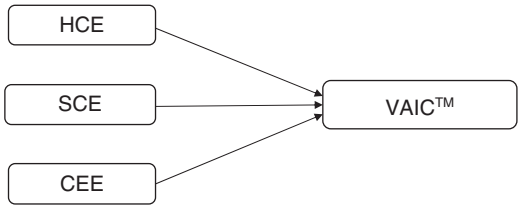
$$\text{HCE} = \text{value added (VA)}/\text{human capital (HC)}$$

$$\text{SCE} = \text{structural capital (SC)}/\text{value added (VA)}$$

$$\text{CEE} = \text{value added (VA)}/\text{capital employed (CE)}$$

3.2 The proposed models

Ante Pulic's VAIC™ model has definite merit over other methods of measuring IC. It is based on audited financial data, has objectivity and verifiability, and can be used for cross-sectional comparisons (Firer and Williams, 2003). Moreover, VAIC™ can readily be used by external stakeholders to assess the intangible assets of a firm. Notwithstanding its popularity, the model has been criticized for producing vague results, especially for capital-intensive companies. The concept of RC has been neglected in this model. The use of SC as a dependent indicator in this model is also problematic (Ståhle *et al.*, 2011).



Source: Pulic (2004)

Figure 1.
VAIC™ model of Ante Pulic

In the extended models being presented in this study, RC has been incorporated as a new variable in the VAIC™ model of Pulic (2004). This is in accordance with the prevailing classification of IC. The proxy for RC is marketing, selling and advertising expenses. It is assumed that such expenses are incurred to establish and maintain relationship with external stakeholders (Nazari, 2010). The proxy taken for HC is the employee cost as well as the remuneration of the directors of a company. The SC of the firms is captured through the R&D expenditure incurred. Selection of these proxies is guided by two factors – according to the literature on IC, what constitutes HC, SC and RC; and second, the availability of secondary data on the proxies selected.

With the addition of coefficient of relational capital efficiency (RCE) to the VAIC™ model, Equation (3) changes to (Figure 2):

$$\text{e-VAIC}^{\text{™}} = \text{HCE} + \text{SCE} + \text{RCE} + \text{CEE} \tag{4}$$

Here, e-VAIC™ is the extended and modified VAIC™ model.

3.2.1 First model (Model-1). In the VAIC™ model, Pulic (2004) has used VA as the success parameter of business. Similar to this, in the first model empirically tested in this paper, VA has been retained as the parameter to verify efficiency of components of IC. In VAIC™, Pulic (2004) exercises discretion in using VA as numerator or denominator to compute efficiency. Nevertheless, the concept of efficiency is best described by the ratio of output to input. Hence, in the present model, VA always appears as the numerator (output). Various efficiencies have been computed as under:

$$\begin{aligned}
\text{HCE} &= \text{human capital efficiency} \\
&= \text{VA}/(\text{employee cost} + \text{director's remuneration}) \\
\text{SCE} &= \text{structural capital efficiency} \\
&= \text{VA}/\text{R\&D expenses} \\
\text{RCE} &= \text{relational capital efficiency} \\
&= \text{VA}/(\text{marketing, selling \& advertising expenses}) \\
\text{CEE} &= \text{capital employed efficiency} \\
&= \text{VA}/\text{capital employed}
\end{aligned}$$

Hence, in Model-1, $\text{e-VAIC}^{\text{™}} = \text{HCE} + \text{SCE} + \text{RCE} + \text{CEE}$, where the efficiency parameter is VA.

3.2.2 Second model (Model-2). Pulic uses VA as numerator/denominator to compute efficiency of variables. This, according to Ståhle *et al.* (2011), inflates the numerical

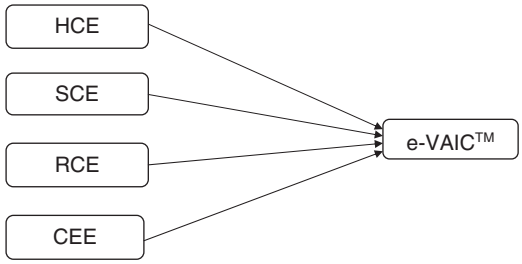


Figure 2.
The extended and modified VAIC™ (e-VAIC™) model

values of VAIC™ (especially in case of capital-intensive companies) and results in vague outcomes. Nazari (2010) has used "net sales" figures instead of VA to calculate variables. Similarly, in the second model proposed for empirical investigation, net sales has been used to calculate the efficiency of variables. Various components of e-VAIC™ have been estimated as:

$$\text{HCE} = \text{net sales}/(\text{employee cost} + \text{director's remuneration})$$
$$\text{SCE} = \text{net sales}/\text{R\&D expenses}$$
$$\text{RCE} = \text{net sales}/(\text{marketing, selling \& advertising expenses})$$
$$\text{CEE} = \text{net sales}/\text{capital employed}$$

Thus, in Model-2, e-VAIC™ = HCE + SCE + RCE + CEE, where the efficiency parameter is net sales.

3.2.3 Third model (Model-3). The two models proposed earlier are efficiency models wherein VA and net sales have been used as parameters for determining efficiency. In the third model presented in this study, similar to Nazari (2010), human capital intensity (HCI), structural capital intensity (SCI), relational capital intensity (RCI) and capital employed intensity (CEI) have been used to determine e-VAIC™. The Intensities shall be calculated as:

$$\text{HCI (human capital intensity)} = (\text{employee cost} + \text{director's remuneration})/\text{net sales}$$
$$\text{SCI (structural capital intensity)} = \text{R\&D expenses}/\text{net sales}$$
$$\text{RCI (relational capital intensity)} = (\text{marketing, selling \& advertising expenses})/\text{net sales}$$
$$\text{CEI (capital employed intensity)} = \text{capital employed}/\text{net sales}$$

Therefore, Model-3 is an Intensity-model in which e-VAIC™ = HCI + SCI + RCI + CEI.

3.3 Dependent variables

The measures of organizational performance are taken as dependent variables for regression equation. In accordance with the existing research studies on VAIC™, two measures of firm performance are being considered – ROA (Firer and Williams, 2003; Shiu, 2006; Gan and Saleh, 2008; Kamath, 2008; Ghosh and Mondal, 2009; Junior *et al.*, 2010; Chang and Hsieh, 2011; Clarke *et al.*, 2011; Phusavat *et al.*, 2011; Mehralian *et al.*, 2012; Pal and Soriya, 2012) and; return on sales (ROS) (Hoskisson *et al.*, 1993; Tallman and Li, 1996; Palich *et al.*, 2000). These dependent variables shall be estimated as:

ROA – calculated as net income divided by average total assets (TA); and
ROS – calculated as EBITDA divided by net sales.

To compute ROA, the predominant practice is to use TA as the denominator. However, since the net income is a flow measure and TA is a static quantity, use of average TA is preferable and is consistent with the matching principle of accounting (Jewell and Mankin, 2011).

3.4 Independent variables

As discussed in Section 3.2, the measures of independent variables are:

HCE and HCI;
SCE and SCI;

RCE and RCI; and
CEE and CEI.

3.5 Control variables

Most of the past studies interlinking IC and firm performance have controlled for firm size, leverage and industry (Firer and Stainbank, 2003; Abidin *et al.*, 2009; Zéghal and Maaloul, 2010; Clarke *et al.*, 2011). Since the firms selected for this study belong to the same industry and are of comparable size, no control variables are being used in the regression equations.

3.6 Operationalization of hypotheses

Multiple regression equations shall be applied on the three new models proposed in this paper to find results and draw conclusions. The resultant analysis shall be used to answer the three hypotheses stated in the Section 2.5. Hence, testing of the proposed models is precursor to the hypotheses testing. For each research hypothesis, all the three new models are being tested. For the third hypothesis, VAIC™ model has been included as well. The multiple regression equation developed to answer first hypothesis is:

$$\text{Performance (ROA; ROS)} = \alpha + \beta_1 \text{ICE(Model-1; Model-2; Model-3)} + \varepsilon$$

In the second hypothesis, impact of components of IC on the performance of pharmaceutical firms in India is to be examined. The corresponding equation shall be:

$$\text{Performance (ROA; ROS)} = \alpha + \beta_1(\text{HCE; HCI}) + \beta_2(\text{SCE; SCI}) + \beta_3(\text{RCE; RCI}) + \varepsilon$$

To address the third research hypothesis, i.e. the comparative analysis of VAIC™ and the proposed models, the regression equation shall be:

$$\text{Performance (ROA; ROS)} = \alpha + \beta_1(\text{Model-1; Model-2; Model-3; VAIC™ model}) + \varepsilon$$

4. Results and discussions

The findings of the regression equations are present in the Tables I-III. Table I addresses the first hypothesis and measures the effect of IC on the performance of pharmaceutical firms in India. Amongst the three models applied to explain the strength of relationship between IC and ROA, the third model (Model-3) has the best coefficient of determination of 14.2 per cent. This model has the highest F-value of 25.217 which is significant at 95 per cent confidence interval. The F-values for Models 1 and 2 are statistically insignificant. In case of ROS as dependent variable, Model-1 ($R^2 = 6$ per cent; F-value = 9.653; p-value = 0.002 significant at $\alpha = 5$ per cent) gives the best performance, the other two models having insignificant F and t-values.

The Table II illustrates the regression results of IC components and firm performance. HC, SC and RC of the three models have been regressed against the two performance variables – ROA and ROS. With a coefficient of determination of

Dependent variable	Model	R^2	F-value	p-value	Coefficients	t-value	Significance
ROA	1	0.022	3.422	0.066	Constant	20.510	0.000*
					M-1	1.850	0.000*
	2	0.013	1.977	0.162	Constant	20.182	0.000*
					M-2	1.406	0.162
	3	0.142	25.217	0.000*	Constant	13.164	0.000*
					M-3	−5.022	0.000*
ROS	1	0.060	9.653	0.002*	Constant	1.427	0.156
					M-1	3.107	0.002*
	2	0.001	0.149	0.700	Constant	2.699	0.008*
					M-2	0.387	0.700
	3	0.007	1.026	0.313	Constant	0.010	0.992
					M-3	1.013	0.313

Table I.
Regression results of IC and performance of firms

Notes: $n = 154$. *$p < 0.05$

Dependent variable	Model	R^2	F-value	p-value	Coefficients	t-value	Significance
ROA	1	0.078	4.204	0.007*	Constant	20.007	0.000*
					HCE	1.725	0.087
					SCE	2.014	0.046*
					RCE	−2.769	0.006*
	2	0.130	7.481	0.000*	Constant	5.518	0.000*
					HCE	3.601	0.000*
					SCE	1.947	0.053*
					RCE	−3.513	0.001*
	3	0.244	16.107	0.000*	Constant	11.745	0.000*
					HCI	−3.085	0.002*
					SCI	−6.151	0.000*
					RCI	1.589	0.114
ROS	1	0.980	2419.869	0.000*	Constant	−19.089	0.000*
					HCE	61.903	0.000*
					SCE	1.834	0.067
					RCE	−1.047	0.297
	2	0.009	0.456	0.713	Constant	2.045	0.043*
					HCE	−1.030	0.305
					SCE	−0.476	0.635
					RCE	−0.096	0.924
	3	0.022	1.132	0.338	Constant	−0.751	0.454
					HCI	1.747	0.083
					SCI	−0.258	0.797
					RCI	0.064	0.949

Table II.
Regression results of IC components and performance of firms

Notes: $n = 154$. *$p < 0.05$

24.4 per cent, Model-3 is the best predictor of ROA for the selected pharmaceutical firms. This result is consistent with the findings of Table I. All the three models have significant F-values. The newly introduced variable, RC, has negative but significant t-values for Models 1 and 2. In Model-3, the same is positive but insignificant. When

Dependent variable	Model	R^2	F-value	p-value	Coefficients	t-value	Significance
ROA	1	0.086	3.492	0.009*	Constant	17.387	0.000*
					HCE	1.801	0.074
					SCE	2.136	0.034*
					RCE	−2.822	0.005*
					CEE	−1.153	0.251
	2	0.134	5.772	0.00*	Constant	4.515	0.000*
					HCE	3.482	0.001*
					SCE	1.667	0.098
					RCE	−3.334	0.001*
					CEE	0.831	0.407
	3	0.252	12.550	0.000*	Constant	11.841	0.000*
					HCI	−2.841	0.005*
					SCI	−5.804	0.000*
					RCI	1.527	0.129
					CEI	−1.290	0.199
	VAIC™	0.612	78.239	0.000*	Constant	−6.101	0.000*
					HCE	−7.153	0.000*
					SCE	9.902	0.000*
					CEE	13.516	0.000*
ROS	1	0.980	1865.730	0.000*	Constant	−17.422	0.000*
					HCE	62.447	0.000*
					SCE	1.596	0.113
					RCE	−0.957	0.340
					CEE	2.257	0.025*
	2	0.032	1.226	0.302	Constant	2.693	0.008*
					HCE	−0.823	0.412
					SCE	0.016	0.988
					RCE	−0.391	0.696
					CEE	−1.874	0.063
	3	0.880	274.361	0.000*	Constant	−5.402	0.000*
					HCI	−0.403	0.687
					SCI	−6.970	0.000*
					RCI	1.778	0.077
					CEI	32.709	0.000*
	VAIC™	0.979	2364.210	0.000*	Constant	−3.380	0.001*
					HCE	73.771	0.000*
					SCE	−3.174	0.002*
					CEE	1.599	0.112

Notes: $n = 154$. *$p < 0.05$

Table III.
Comparative analysis of proposed models and VAIC™

ROS is the dependent parameter, Model-1 has the highest value of coefficient of determination ($R^2 = 98$ per cent). The F-value is 2419.87 and is significant at 95 per cent confidence interval. The F-values of other two models and most of the t-values (except HCE of Model-1 and constants of Models 1 and 2) are not statistically significant (at $\alpha = 5$ per cent).

In Table III, results of the third hypothesis, i.e. comparative performance of the three proposed models *vis-à-vis* the VAIC™ model, have been shown. For ROA as the measure of firm performance, the VAIC™ model has the highest R^2 value of 61.2 per cent followed by Model-3 ($R^2 = 25.2$ per cent), Model-2 ($R^2 = 13.4$ per cent) and Model-1

($R^2 = 8.6$ per cent). The F-value is significant for all the four models. The t-value of RCE is significant but negative for the Models 1 and 2. In Model-3, the RCI is statistically insignificant at $\alpha = 5$ per cent. In the case of ROS as dependent variable for firms' performance, Model-1 gives the best result with R^2 value of 98 per cent. This is marginally better than the coefficient of determination of VAIC™ which has the value of 97.9 per cent. Model-3 with R^2 value of 88 per cent and Model-2 ($R^2 = 3.2$ per cent) follow. Apart from Model-2, the F-value is significant for all the other three models. For ROS, the t-value for the newly introduced variable RC is not significant for all the three models proposed in this research study.

The results of the data analysis have been summerized in Table IV. Cases of positive relation between IC and performance of firms support the first two hypotheses. When IC is measured at aggregate and component levels, Model-3 is the best predictor of ROA. However, in case of ROS, Model-1 has shown better results. The R^2 values have generally remained higher when ROA was taken as dependent variable. This suggests that between the two variables – ROA and ROS, ROA shall be the preferred parameter for performance assessment of pharmaceutical firms in India. This inference holds true for the first two hypotheses. The scenario, however, changes while investigating the third hypothesis. When CE, the proxy for physical and financial capital, is added to the models, ROS becomes the preferred choice as performance variable. During comparative analysis of the three proposed models and VAIC™, the VAIC™ model has high R^2 value for both – ROA and ROS. Nevertheless, in case of ROS, Model-1 is marginally better than VAIC™. Addition of RC as a new variable in the proposed models has failed to significantly impact the models. Statistically significant t-values of RC are found only for Models-1 and 2 and that too, with negative values for t-statistics.

5. Conclusion

This research paper aims to measure IC of Indian pharmaceutical companies and its impact on their performance. It is also a preliminary attempt to develop models which can measure IC of firms through secondary data. For measurement of IC and its components and their impact on the performance of firms, VAIC™ model of Pulic (2004) provides the template. But, since VAIC™ does not incorporate RC in its model and leads to overvaluation of capital-intensive companies, this paper extends and modifies the basic VAIC™ model to address these shortcomings. Consequently, three new models have been proposed and empirically tested.

The regression results on the data set selected for this study show instances of positive relation between IC and its components (independent variables) and performance (dependent variables). This is especially true when the performance variable is ROA. The findings are analogous to the results reported by Mehralian *et al.* (2012) in Iran, Kamath (2008) in India, Sharabati *et al.* (2010) in

Table IV.
Summary of results

Proposition empirically tested	Dependent variable	Best-fit model
IC of firms are positively related to their performance	ROA	Model-3
	ROS	Model-1
Components of IC are positively related to performance of firms	ROA	Model-3
	ROS	Model-1
Comparative analysis of VAIC™ and the proposed models	ROA	VAIC™
	ROS	Model-1

Jordan, Bollen *et al.* (2005) on the German pharmaceutical firms, Chen *et al.* (2010) on US healthcare industry and Pal and Soriya (2012) and Ghosh and Mondal (2009) on Indian firms. In case of ROA, Model-3 gives the best values for coefficient of determination. When ROS is the performance variable, Model-1 has the highest R^2 values. The regression results indicate that for studying the impact of IC on performance of pharmaceutical firms in India, ROA should be preferred rather than ROS. However, if physical capital (CE as its proxy) is included in the model along with IC, regression results are robust for ROS instead. To examine the third hypothesis, a comparative analysis of the models was done. During this investigation, VAIC™ gave better results when ROA was the dependent variable. In comparison, when dependent variable was ROS, Model-1 provided better results. Based on popular typology of IC, RC was added as a new variable in the proposed models. In majority of cases, this variable has not shown significant relationship with the performance variables. Hence, irrespective of theoretical support for RC, this variable is of little empirical value in the models.

The findings of this research work have implications for practitioners as well as academicians. Managers may use the results for value creation and evaluation purposes. There is a stream of researchers who use secondary data for assessment of IC. For such scholars, this paper presents alternative models for valuation of IC. Since most of the researchers have used original VAIC™ model only, this paper adds novelty with inclusion of RC as a new variable in the model. Use of new proxies for components of IC is the other innovativeness of this paper. Ståhle *et al.* (2011) have written extensive criticism on the VAIC™ model. The authors highlight issues such as non-inclusion of RC in the model, discrepancies arising due to use of VA and overlapping variables, simultaneous use of flow and static measures in the VAIC™ equation, etc. This study mitigates these shortcomings by proposing new models which are theoretically consistent.

This research work has few limitations. First, the limitations inherent in the VAIC™ model are applicable to the proposed models as well (e.g. inability of VAIC™ to measure IC in greater details as demonstrated by DIC and SC methods). Second, non-availability of data on most of the variables/components of IC due to their inadequate/non-reporting by firms affects the choice of proxies being used for various components of IC. Lastly, since this study has been conducted on a single industry, generalization and extrapolation of findings will require caution. This study is context and data-specific which leaves a scope for extension of this work. Further study can be done with a multi-industry data set for better generalization of results. Researchers may also contemplate use of other proxies for development of newer models for valuation of IC.

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