Intellectual Capital and Organizational Performance: an Empirical Study of the Pharmaceutical Industry

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Abstract: This paper directly measures the impact of intellectual capital management on organizational performance. Although this is an area widely studied in the literature, the nature of most of the work to date is to focus on specific aspects of intellectual capital (human, structural, or relational capital) and their individual impact on performance. This study specifically looks to identify firms that manage overall IC, whatever its nature, better than competitors. We then ask the question, do these firms actually see market results better than those of competitors?

In order to do this type of analysis, we felt a need to focus on a specific industry. If wide differences do exist between industries in terms of physical capital needs and human, structural, or relational capital needs, then random firms are harder to compare. Those within a single industry, such as the pharmaceutical firms studied here, should have relatively similar structures in relation to all these needs. We collected data on 139 firms in the drugs industry. We sorted and divided the sample according to market capitalization and book value (a common measure of intellectual capital) then looked at return on assets, investment, and equity, as well as beta. By one measure, firms with the highest level of intangible assets clearly performed better than those with lower levels. The high level firms had significantly better returns and significantly less variability in stock price. According to a second measure, the results were less convincing but still lent support to further research using this methodology.

So, as a first cut, this study had very promising results. We intend to repeat it for other industries, experimenting with the measures and means of cutting the data. Although industry-specific is obviously the initial way to go, we also intend to perform some cross-industry comparisons with the measures we develop. We believe the results of the full research program will be significant to practice and will provide substantial support to those championing better management of intangible assets within firms.

Keywords: intellectual capital, knowledge management, organizational performance, market/book ratio, ROA, ROE, ROI, beta

1. Background

The advent of the “knowledge economy” has engendered a great deal of interest in how intangible knowledge assets or intellectual capital (IC) are managed in organizations. The implicit or explicit assumption in both practical and scholarly work is that better management of IC will lead to unique, sustainable competitive advantage. Consequently, a great deal of time and effort have been expended on measuring IC, on developing systems and tools to manage it, and, to a more limited extent, estimating the impact of IC on performance. IC management is, of course, a variation on the concept of knowledge management. We choose to use the former term in this article given our emphasis on financial data and measurement of knowledge assets. The latter term is more often used with the techniques and systems employed in managing those same knowledge assets.

Given the case many scholars and practitioners make for the potential in better managing knowledge assets, it's surprising that work in this area has been relatively limited. There have been studies on whether and how specific areas of intellectual capital contribute to better organizational performance, but very little work exists on whether better overall IC management translates into better financial results. We’ll discuss some of the existing work shortly.

Thus, this study is an initial exploration into the impact of better management of the full range of knowledge resources on overall organizational performance. We concentrate on a single industry so as to eliminate issues such as type of IC and the impact of industry structure and rivalry on financial performance. Although the measures employed are fairly broad, we do believe them to be enlightening and, as the results show, worthy of significant additional exploration.

The idea that superior knowledge of managers and workers can lead to competitive advantage is not new but the more formalized concepts of intellectual capital and knowledge management really took flight only in the 1990's. Based on insights from sources as disparate as Schumpeter and Drucker, the literature began to

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evolve, recognizing that competitive advantage could come from the human element of the firm. Indeed, the resource-based theory of the firm reinforced the idea that competitive advantage flows from unique resources of the organization (Nelson & Winter 1982), eventually leading to sustainable core competencies (Prahalad & Hamel 1990). As capital and basic labor became readily available to most organizations of any size, scholars began looking for other factors that might explain why one firm is successful and another is not.

Parts of the discussion focused on intangibles, and we're all familiar with concepts such as goodwill and brand equity, so the idea that intangible assets have value is also nothing new. Indeed, the Tobin's Q measure of intangibles (market value to replacement cost of assets) goes back decades. Newer measures developed during the 1990's include the Balanced Scorecard (Kaplan & Norton 1992). These two approaches (two of many, see Tam, Plowman & Hancock 2007 for a review) reflect a major difference in approach, with most scholars in the last decade following the latter. The earlier approaches took a very broad approach to assessing intangible assets—as is the case with Tobin's Q and its remainder technique (what's left over after subtracting out the tangible assets is the value of the intangible ones). More recent approaches such as the Balanced Scorecard look to identify the specific pieces of intellectual capital and evaluate their individual impacts.

Another strand of IC theory suggests that two types of knowledge assets exist, tacit and explicit (Nonaka & Takeuchi 1995). Tacit knowledge is typically in the heads of employees, hard to express or capture. Explicit knowledge is codifiable, sharable, and able to be captured by contemporary IT-driven knowledge management systems. Theory and practice also deal with a different but equally important division of IC into the categories of human capital (HC, what people know about their jobs), structural capital (SC, corporate infrastructure, information systems, and culture), and relational capital (RC, what people know about interacting with those outside the organization, including suppliers, customers, regulators, etc.) (Bontis 1998; Edvinsson & Malone 1997, Stewart 1997).

These directions have been fueled by practice as knowledge management installations are specifically designed to capture the explicit knowledge of the firm, to turn some tacit knowledge into explicit, and manage and share tacit knowledge by other means. And practicing managers have also been interested in measuring and managing explicit and tacit knowledge organized into the more specific HC, SC, and RC categories. So IC reports, such as Skandia Navigator, look to identify and measure the amount of these specific knowledge assets within a firm (Edvinsson & Malone 1997). National or regional IC reports have followed related formats (Bontis 2003; Pasher 1999). The obvious question is what to do with such data and whether these measurements lead to actual improvement in organizational performance..

This is the area on which much of the performance evaluation literature has focused. The scholarship has tried to better identify the specific pieces (HC, SC, RC are often but not exclusively used) and then measure impact (Marr & Schiuma 2001). And although the best-known frameworks do include overall assessments of IC, they also include the component parts. Indeed, the studies that employ them tend to focus on the component parts. Lev's well-known work, for example, looks at the overall valuation and physical capital employed, but then often focuses in on a specific part of the remainder such as R&D or structural capital, looking to estimate impact (e.g. Lev & Radhakrishnan 2003). Similarly, Pulic's (2004) VAIC system, widely used by both practitioners and academics, measures the full range of IC but is typically employed only on a single component in academic studies (e.g. Firer & Williams 2003, Chen, Cheng & Hwang 2005, Tan, Plowman & Hancock 2007).

There are a number of very practical reasons for these tendencies. Overall, IC can be a fuzzy concept. Although we have several suggested ways to estimate it, none are bulletproof. Further, the makeup of IC components varies widely by industry, so the nature of $10 billion in intangible assets in the microprocessor industry is very different from $10 billion in intangible assets in the investment banking industry. And the differences matter to practicing managers. Finally, breaking the knowledge assets up into pieces allows for academics or consultants to conduct analyses of individual companies, including those not listed on stock exchanges (so non-public firms can be studied and/or employ IC assessment). Strong reasons exist for burrowing deeper into the IC of a firm, differentiating tacit from explicit knowledge assets and separating out the human, structural and relational components.

Our perception is that such approaches miss an opportunity to more firmly establish the impact and importance of IC on a broader scale. Directly comparing high IC performance firms with lower IC performance firms would help to demonstrate the power of harnessing and better managing knowledge

assets. Consequently, we seek to go beyond the established literature and assess the effect of better IC management, in total, on financial performance.

2. Methodology

As noted, performance evaluation studies in this field have typically focused on specific types of intellectual capital and their impact on financial results. At least part of the reason is the interest in what parts of IC have the most impact on organizational performance. Is human capital or structural capital more important? What about relational capital? But another reason for this emphasis is the differences between industries. Human capital can be more important in an industry requiring expertise built up over time. Structural capital can be critical in industries demanding an extensive IT infrastructure or strong corporate cultures. Relational capital can be more important in an industry requiring close supplier contacts, close customer contacts or strong brands, or requiring substantial regulatory compliance. The importance of a particular class of knowledge assets can vary widely by industry (Rothberg & Erickson 2005). So if we are to consider the impact of overall IC on performance, industry considerations certainly need to be taken into account.

Consequently, this study focuses specifically on one industry and addresses the question of whether firms appearing to do a better job managing IC also perform better financially. An industry-specific approach allows us to control for differences in physical capital requirements as well as different levels of human, structural, and relational capital. Everyone competing in a given industry needs similar physical capital assets, employees with similar skills and abilities, and will reflect the same basic ratios concerning all of the above. As a result, we can look precisely at a basic measure of firm-wide IC development and its seeming effect on common measures of organizational performance without worrying about huge variations in physical capital, human capital, structural capital, or relational capital.

We chose the pharmaceutical industry for this initial comparison for several reasons. Pharmaceutical firms traditionally have certain physical asset requirements for R&D and production as well as heavy investment in intellectual property (which is an intangible asset and a formalized piece of intellectual capital). Pharmaceutical firms also particularly require considerable human capital in R&D, production, marketing and sales, and other areas; can have structural capital in their IT systems, corporate culture, and areas of specialization (e.g. cancer, hypertension); and can have relational capital concerning research partners, the FDA, and sales targets such as physicians, insurance companies, and pharmacies. We know knowledge is critical to this industry, whether formalized or not. So IC would seem to be a particularly important factor, can be important in all of its components (and in similar proportions across companies), and is as identifiable as it is likely to be in any industry.

The basic hypotheses behind this study are straightforward. Firms within an industry doing a better job of managing IC should see better performance. We choose to measure IC in the most basic manner, market value less book value. Tobin's Q suggests that market value to asset replacement value is the key to understanding intangibles. But the difficulty has always been measuring replacement value. Book value has frequently been used as a workable proxy. Thus, this measure is well-established in the literature and, although broad, readily identifies those organizations doing a better job with their knowledge assets. A greater difference between market value and book value indicates a firm developing more intangible assets. Ceteris paribus, more intangible assets suggest a better job of managing intellectual capital. If you can build substantially greater intangible assets, especially those recognized by investors, you are seemingly doing a better job managing those intangible, knowledge assets. You are building IC that other firms are not.

As noted in the literature review, other, more specific and perhaps more sophisticated, IC measures are available. We chose the basic measure for a couple of reasons. Initially, at this point, we don't plan to divide IC into its component parts, we are more interested in a single measure of all knowledge assets that is robust enough to eventually repeat across numerous industries (aerospace/defense, investment banking, and asset management banks are in process). Secondly, these data are readily available for a large number of firms within multiple industries, adding heft, reliability, and, again, repeatability to the research program.

In terms of performance, the most obvious and commonly used measures seem the way to go. As this is our initial study, we tried out several alternatives, gathering data on return on assets (ROA), return on equity (ROE), and return on investment (ROI). The first (ROA) is the most universally reported figure, revealing less gaps in the data set. We also collected betas, the often-used measure of risk through variability in stock movements relative to market variability. In a preliminary study, we weren't really looking to formally test hypotheses, but the basic idea is the following:

Proposition: Higher levels of intangible assets should yield:

- Higher ROA
- Higher ROI
- Higher ROE
- Lower beta

As we are able to take a closer look at the data, other measures and/or other means of employing the data may also prove to be useful. We'll discuss some of these possibilities later in the paper.

We collected financial data from Standard & Poor's Research Insight/Compustat, specifically SIC Industry Group 283: Drugs. We gathered standard financial status and performance data including market capitalization, book value, return on assets, return on equity, return on investment, beta, and several other measures from fiscal 2004. The final list included 139 companies traded on North American stock exchanges, though not all data were available for all companies.

3. Results

We ran some preliminary summary statistics to judge the nature of the data. There appeared to be some promise in the numbers, so we moved on to more formal ANOVA procedures which are also more firmly established in the literature and allowed in-depth comparison of the group means.

As noted earlier, the pharmaceutical industry has both physical assets and intangible assets. From a data set of 130 publicly traded firms in this industry, the average level of market capitalization was $11.4 billion and the average shareholder's equity was $2.92 billion, the latter indicating substantial physical assets. The difference between the two figures shows almost $8.5 billion in intangible assets per company, or a ratio of almost 3:1 of intangible to tangible assets.

In analyzing the data, there are two possible approaches. On the one hand, the difference between market capitalization and shareholders' equity could be treated as exactly that, the absolute difference between the numbers. Those firms generating a large number would possess large amounts of intangible assets or intellectual capital. With this approach, however, larger firms with longer histories would clearly have a higher likelihood of being classified as more successful in managing IC. Small firms, though potentially very successful with IC might simply not have a high enough asset level to rank highly. Using differences has potential but also favors larger, established firms. Further, the really small firms with potentially big swings in returns would be grouped in one category, potentially skewing the results.

On the other hand, this issue can be partially resolved by using a ratio of market capitalization to shareholders' equity as the measure of IC management capabilities. With a ratio, all sizes of firms are on a more even basis. Indeed, this method runs the risk of having some particularly small firms having too much influence over the results. A startup, for example, with a very high stock price would rate very highly according to this measure even though its IC may or may not pan out in the future. But, generally, listed firms have some credibility to their market caps, and really outrageous numbers can be weeded out using either approach (especially the former, where, again, the obviously extreme results are all grouped near the bottom of the ranking). We employ both in this study in order to start the discussion over the best methodology for determining the impact of better IC management.

Table 1 contains the results from the difference approach. The market cap/shareholders' equity difference was calculated for all firms in the sample. All were then ranked. Once this was done, as expected, it became apparent that the very smallest firms had dramatically different results in terms of returns—not so much in one direction or in size but rather in the wide swings in value. As a result, the sample is truncated, dropping the very smallest firms. The remaining firms were divided in half, and the beta, ROA, ROE, and ROI of the groups were compared.

Table 1: IC Performance (Differences) and Financial Returns

	Mean	Variance	F (F-crit = 3.96)	P-Value
Beta	1.00 (42) 1.41 (42)	0.74 1.21	3.69	0.058**
ROA	- 6.57 (44) -25.89 (44)	1153.75 885.67	8.05	0.006*
ROE	-16.55 (42) -51.78 (40)	8147.16 7981.22	3.15	0.080**
ROI	-13.99 (44) -43.23 (43)	4680.64 4981.96	3.85	0.053**

*Significant at the 95% level

**Significant at the 90% level

As noted in the table, the results are as expected. The group less successful at developing intellectual capital has better ROA, ROE, and ROI, and all are significant at the 90% level (two at or very close to the 95% level). Further, the betas are lower for the better-managed group, also significantly different at close to the 95% level. The results are in the expected direction and are significant. Regardless of how financial performance is measured, better IC management is associated with better returns.

The results are a bit less convincing with the ratio approach. Since the odd results were not as obviously concentrated in one group or another using this method, we included the full sample, where data were available. The results are mixed. The beta and ROA findings are in the expected direction, the ROE and ROI findings are not. None of the results are significant above the 85% confidence level. There may be several reasons for this. Initially, the odd results, while not concentrated in one group or another, result in such large variances that the overall findings are skewed. Secondly, as should be obvious from the values of the highly negative mean returns, 2004 appears to have been a poor year for the pharmaceutical sector as a whole. Consequently, returns for some firms, even if conceivably managing IC well, may have swung wildly in the negative direction due to other risk factors. Of course, this latter does little to explain why the results are so different from those found using the difference method. The topic obviously needs more study.

Table 2: IC Performance (Ratios) and Financial Returns, Full Sample

	Mean	Variance	F (F-crit = 3.92)	P-Value
Beta	1.34 (59) 2.69 (65)	0.96 87.79	1.22	0.271
ROA	- 27.49 (61) -115.52 (69)	2001.82 222988.80	2.10	0.150
ROE	-98.38 (58) -40.34 (54)	122245.20 8364.70	1.40	0.240
ROI	-54.97 (61) -37.76 (59)	10579.03 5325.00	1.11	0.294

4. Discussion and conclusions

These initial results are relatively encouraging. They lend at least some support to the propositions/hypotheses and the methodology. We look forward to extending the analysis to other industries, particularly those with different IC structures in terms of the importance of KM and the breakdown of HC, SC, and RC. As noted earlier, we have already begun initial data analysis of aerospace/defense, investment banking, and asset management banking. We also hope to extend the analysis to years or sectors with more positive returns.

In doing so, there are several obvious improvements, other directions that could improve the analysis. Initially, our cutting of the data, while not *ad hoc*, could probably use some more thought. There may be justifications, including previous studies, for dividing firms differently, especially if a different approach allows

us to more confidently include or exclude the low IC firms (with their high variability and idiosyncratic numbers). We intend to look for a more systematic manner for dividing up the database that will naturally extend to further studies.

This study also presents only one way of analyzing the concepts of successful IC management and organizational performance. In the former area, we used the difference between market and book value. This measure will tend to favor larger firms, who may have more intangible assets because of sheer size, not because they are clearly better at managing such assets. An alternative way to approach this measure is a ratio of market to book value. This eliminates the size issue. But it brings back into the equation the issue of smaller firms with wild variations in stock price and ROA. A combination of judicious cutting of the data set and the combined use of both market/book measures is an obvious next step.

And the clarity and choice of return measures could also be extended. In this study, we used ROA, ROE, ROI, and beta. It's not altogether clear why we see the difference in the first three in the ratio results in Table 2. While they do measure different things, they are also similar in some regards. It seems counterintuitive that we should see such different results. Testing differences in the variances of the measures or other data could also be of interest.

This study also contains only one year of data. As market value, returns, beta, and other measures can vary dramatically from year to year for reasons that have nothing to do with what we're trying to assess in this research program, we have a problem. Some of the problem is eliminated by looking at a large sample of firms. But multiple years of data would prove even more useful, washing out most of that variability altogether.

Finally, some correlation analysis will also be appropriate as we extend the work.

This preliminary study suggests that a strong relationship may exist between successful development of intellectual capital and organizational performance. We look forward to expanding the analysis to a broader field and in an even more convincing manner.

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