

# Predictive Analytics: Digital Metrics for Estimating Knowledge Assets

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**Abstract:** Digitization, big data, and follow-on metrics have burgeoned over the last couple of decades. While the knowledge management (KM) community has embraced some of the advances in data-driven decision-making in business, there remain new applications that are relatively unexplored. One of these applications is the use of digital metrics to estimate knowledge holdings or intellectual capital (IC). In a discipline still at the mercy of troublesome metrics, new opportunities to better measure IC would fill a large gap in the existing body of knowledge. Previous work, across several industries and well-known brands, established digital media variables of interest such as volume of mentions, variability of mentions, influencer quality, brand sentiment, and some more platform-specific (X, Facebook, etc.) measures (Erickson, 2023; Erickson & Rothberg, 2023; Erickson, Schmidt & Rothberg, 2020). These indicators were compared with brand equity from a separate source and methodology, establishing apparent links. In short, certain digital media variables seemed related to higher brand equity, a proxy for the intellectual capital component of relational capital. More recent research explored the statistical link between digital metrics and brand equity (relational capital) (Erickson & Rothberg, 2024). On a very small sample, key indicators were shown to predict brand equity values at a very high correlation using different approaches (regression, neural network). This study continues that work, with a larger set of firms. The firms are drawn from two industries, autos and information technology, both of which have a number of companies with available brand equity estimates. Moreover, the study adds price/book value ratios, calculated on an annual basis (like brand equity) but which can also be easily estimated for shorter time periods by altering share price. As a result, in estimating correlation, periodic digital media independent variables can be compared not only with annual brand equity metrics but with matching periodic price/book ratios. Price/book is an effective proxy for not just relational capital but all intellectual capital of the firm, providing a different approach from a new perspective.

**Keywords:** Intellectual capital, Relational capital, Knowledge assets, Brand equity, Sentiment analysis, Predictive analytics

## 1. Background/Literature Review

Intellectual capital (IC) metrics remain a difficult concept for researchers. While a wide range of options exist, those that work best can only really be used on a firm or two at a time. Those looking to evaluate a wider sample of organizations have their advantages but not nearly the depth or capacity for applied analysis on how and why different approaches yield different levels of success. The discipline also increasingly relies on self-report surveys raising obvious questions about subjectivity and the respondent's capabilities in judging the organization's success in managing intellectual capital or knowledge.

This study continues a broader research program to investigate new and innovative approaches to estimating the intellectual capital of the firm. Previous efforts have focused on relational capital, in particular, and how contemporary social media metrics, including sentiment analysis, can be applied gain a sense of the relative success of different entities in managing intangible assets. This paper broadens that effort by looking at two industries populated with a number of high brand equity (relational capital) competitors as well as an alternative, more widely available output metric (price/book ratio). The results are encouraging, potentially providing new, easily implemented metrics for comparing multiple firms and their knowledge management (KM) efforts in a large sample.

### 1.1 Intellectual Capital

Previous studies have broken the ice on this topic and developed background on the concepts of intellectual capital (IC) in general and relational capital (RC) and brand equity in particular. In the interest of saving space and featuring some of the newer research on applying digital media metrics to estimating the value of a firm's intangible assets, this literature review will cover IC, RC and brand equity only briefly. Fuller literature reviews, as noted, are available in previous work (Erickson & Rothberg, 2024; 2023; Erickson 2023).

Intellectual capital is essentially the score-keeping side of knowledge management (KM), defining and measuring the intangible assets (knowledge) of the firm (Bontis, 1999; Edvinsson & Malone, 1997). KM theory suggests that better management of these knowledge assets leads to competitive advantage in the marketplace (Grant,

1999; Teece, 1998), and IC is the means to better understand and account for this knowledge, allowing more effective growth and application.

As a result, IC can be an important tool in trying to assess the impact of better knowledge management on firm performance. If knowledge really is a key competitive differentiator (Nonaka & Takeuchi, 1995), we should be able to capture the construct and its influence on profit, margins, innovation, etc. So how do we define and measure IC?

The most common breakdown in the field remains human capital (individual knowledge on how to perform one's job), structural capital (processes/procedures captured by the organization), and relational capital (knowledge about external entities, particularly customers) (Bontis, 1999). Much of the literature on knowledge management concerns how to better capture individual human capital and turn it into more of an organizational structural capital asset. Relational capital (Roos & Roos, 1997) has been less addressed. Termed customer capital in early IC frameworks, relational capital was coined as the more inclusive term, bringing in other external concerns such as suppliers, local communities, regulators, and others, but the vast majority of relational capital asset value still comes from customer knowledge.

The lack of emphasis on relational capital is also evident in some of the common IC metrics. Sveiby's (2010) well-known catalog counts over 40 published approaches, including recognizable frameworks such as the Balanced Scorecard (Kaplan & Norton, 1992). Sveiby differentiates between those methods usually applying company-specific information or non-dollar measures, both harder to apply across multiple firms (if the data can even be obtained) vs. approaches making use of readily available, objective, dollar-based inputs from financial statements such as Pulic's (2000) VAIC or Tobin's q (Tobin & Brainard, 1979). But Pulic's approach does not have a separate relational capital component (it is lumped in with structural capital) and the Tobin metric measures only overall IC, not the individual components. Whether a specific objective measure can deliver the detail desired by KM practitioners remains an open question.

Relational capital, then, is an understudied and under-measured concept. And, as we'll discuss, one can certainly make the claim that customer knowledge in an age of big data and relationship marketing is a burgeoning and increasingly important intangible asset in organizations. Relational capital builds through repeated successful interactions between the seller and the customer. The seller accumulates data, often on individually identifiable buyers, and learns what satisfies that customer (Sussan, 2012; Stahle & Stahle, 2012). In other contexts, this value is often referred to as brand equity. Turning the vast pool of customer data into actions delivering loyalty demonstrates deep brand equity and relational capital (Change & Tseng, 2005; de Castro, et al., 2004). So what can we take from the available data and related marketing concepts to change our thinking on how we might measure relational capital or even full intellectual capital in organizations?

## **1.2 Brand Equity and Digital Media**

As above with IC, the branding literature has also been fully explored in previous work related to this study (Erickson & Rothberg, 2024; 2023; Erickson 2023). More associated with marketing as branding is one of its core concepts, a unique and valuable intangible asset. But, again, the value of a brand is not in a catchy name or logo but in its record of repeated satisfactory interactions with customers. Customers build expectations about what the brand will deliver, and if the experience matches those expectations, the buyers are satisfied and will continue with the brand. Their purchases, then, as they use the brand as an indicator of their expected satisfactory experience, show value in the identifying brand itself (Seggie, et al., 2006; Aliwadi, et al., 2003; Keller, 1993; Aaker, 1996; 1991).

More recently, brand value is associated not just with product use experiences but also digital interactions surrounding the brand, including website and in-store activities, social media activity, loyalty program activity, and other data collection opportunities. Information and communication technologies enhance interactions and have expanded individualized, identifiable contact between buyer and seller (Lechman, 2017). The result is a wealth of data concerning users that can be used to build knowledge, not only on an aggregate but on a personalized level (Rothberg & Erickson, 2017; Sigala & Chaikiti, 2014; Levy 2009).

From that point, it's a fairly straightforward logical step to suggest that data drawn from digital interactions could be used to assess the value of a brand or, alternatively, the level of knowledge assets constituting relational capital. To some degree, organizations have long realized that comments on social media provide some insight into how users feel about a brand, with contributors providing uncensored positive and negative comments (Rovai, 2002). Moreover, the content can go into unusual depth, providing meaningful guidance about true feelings toward the brand (Rizun & Kucharska, 2018).

As a result, social media metrics are now being recognized as a potentially valuable input in estimating brand equity on both the academic side (Fagundes, et al., 2023) and on the applied/consulting side (McDowell, et al., 2023). While research has commenced on the details of the relationship such as how user involvement, participation, and expression through social media might be linked to brand awareness and loyalty, such studies also point out the need for much more attention to the topic in these still early days of academic research (Fagundes, et al., 2023; Algharabat, et al., 2020).

This paper contributes to filling this gap, adding to what we know about the relationship between digital media metrics and brand value. Applying learnings from recent research, the study also extends the findings by including objective data, going beyond subjective self-report surveys. Although not definitive, and this paper only presents the initial insights from the study, it provides guidance to coming research including much larger datasets and a range of interesting variables.

## **2. Methodology**

Previous studies used to explore and establish a methodology around digital metrics and brand value (relational capital) employed a brand equity outcome variable sourced from marketing consultancy Interbrand (Erickson, 2023; Erickson & Rothberg, 2023; Erickson, Schmidt & Rothberg, 2020; Erickson & Rothberg, 2017). Interbrand (2025) publishes a list of the Top 100 Global Brands every year as well as some more focused lists (Top 100 Chinese Brands). Their methodology is proprietary but does give a reasoned, concrete number to brand value. On the other hand, only the largest, best-known brands are included providing sharp limits on available brands to study. For this study, one objective is to move toward an alternate, more readily available brand value metric. The easily accessed (stock) price/book ratio is therefore included and will be covered shortly.

Two industries were chosen, each with multiple strong brands present in the Interbrand rankings, automobiles and information technology. Autos are obviously a more consumer-oriented brand while the info tech brands were purposely chosen as those with a greater business-to-business emphasis. These industries should be very different in terms of their approach in branding. As a result, both similarities in spite of the differences and dissimilarities should be of interest. When setting up the data collection earlier in the year, Tesla was included given its place as a Top 10 brand as was Chinese provider BYD. A lot of recent political news has impacted the Tesla social media results while the brand value indicator, based on last year's financials, stayed constant. There was some discussion on whether to keep Tesla in the data pool, but in the end we decided to report the results. The results can be rerun without Tesla as a future extension of the research.

Data used in the study were collected over four weeks, February 25 to March 24, 2025. The Sprout Social listening platform was used for data collection. Previous studies had employed Salesforce Social Studio, but that platform has been discontinued by the provider. Sprout Social is similar in that its listening function, when provided a prompt such as a brand name, will scrape the internet for social media activity (e.g. X, Reddit), shared media (YouTube), blogs, and other web mentions. As we'll see in the results, these mentions can run into the millions or even billions for a keyword on a daily or weekly basis. Consequently, the potential exists for objective, big data studies of global feelings toward brands and a volume of data well beyond what researchers in the field can usually gather.

For the dependent variable, brand value, the Interbrand 2024 Best Global Brands and related rankings were used to estimate brand equity (Interbrand 2025). In addition, as noted, we added a second potential brand value estimator in the price/book measure was obtained off *The Wall Street Journal* financial data quotes website (WSJ, 2025). The new metric has a couple of possibilities. One, as noted earlier, is based on the possibility that relational capital makes up an ever-growing part of intellectual capital in an era of digital business and marketing. An overall IC indicator may be dominated by the RC component and so could be used as a proxy measure for brand value and relational capital. Alternatively but relatedly, one could ask whether digital media data can be used to assess IC in general as opposed to just RC. If so, it is again a potentially useful tool in better understanding the role of intellectual capital in the competitiveness of firms.

As noted, data were gathered for auto brands and B2B IT brands. For the former, top brands include Toyota, Mercedes, BMW, Tesla, Honda, BYD, Hyundai, VW, Ford, and Nissan. For the latter, top brands include Microsoft, Cisco, Adobe, Oracle, IBM, SAP, Nvidia, Intel, and Salesforce. Data generated by Sprout Social and included in the analysis were volume (messages/day), potential impressions (views/day, number of times audience could have viewed messages based on followers), engagements (actions/day, number of times messages were publicly interacted with), and sentiment (percentage positive, users' feelings about brand). Standard deviations for each metric were also calculated and included in the analysis.

Statistical work was done on SAS Viya allowing easy addition and deletion of variables with immediate feedback on each variable’s significance and its influence on the significance of already included variables. SAS Viya also has multiple options for modeling, including various regression approaches, a neural networks option, and specialized techniques such as clustering or decision trees. Moreover, the platform allows easy comparison of the quality of each model’s outcomes. The results included here are limited due to space and so provide only a taste of what is possible with the data and the analysis software. As will be noted, the results call for much more, much deeper analysis, analysis that can be performed by the SAS Viya system.

### 3. Results and Discussion

Initially, we performed a correlation analysis on each of the available variables in the models. We expected considerable overlap in the data we were tracking and wanted a sense of how big those relationships might be. The full dataset included:

- Brand equity (dependent variable)
- (Stock) price to book (alternate dependent variable)
- Volume of digital media conversations
- Volume standard deviation
- Sentiment (positive)
- Sentiment standard deviation
- Impressions (potential reach of each conversation)
- Impressions standard deviation
- Engagement (user interaction with content/conversations)
- Engagement standard deviation

Results are included in Figures 1 and 2. As expected, correlations are high, as indicated by the darker blue results, especially among the consumer-oriented automobile brands. More volume of chatter is likely to lead to more impressions (more initial posts would lead to more follow-on shares or posts) as well as more engagement (more initial posts and follow-on impressions could lead to more interaction). Interestingly, in the auto brands correlation, sentiment is not highly correlated with much of anything nor is the outcome variable brand equity. For B2B IT brands, sentiment is more closely correlated with a number of the other variables but neither outcome variable shows singular attachment to any of the explanatory variables. The fuller analysis sheds further light on those relationships, but one would expect considerable collinearity within most models, not diminishing their overall predictive power but limiting the reliability of individual component results.

We then ran linear regressions on each data set for both outcome variables. Initially, all explanatory variables were included but then removed sequentially in order of significance (those with the least significance came out first). Given the high degree of correlation between some of the variables, these steps unsurprisingly served to increase the significance of some of the remaining variables. After several iterations, the regressions with the highest explanatory power and the clearest contributions from independent variables were identified. These are included in Tables 1 and 2.

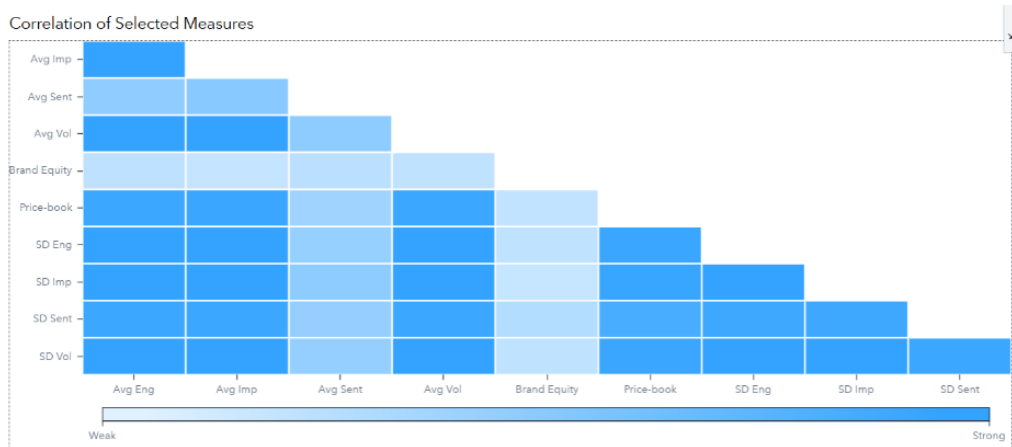
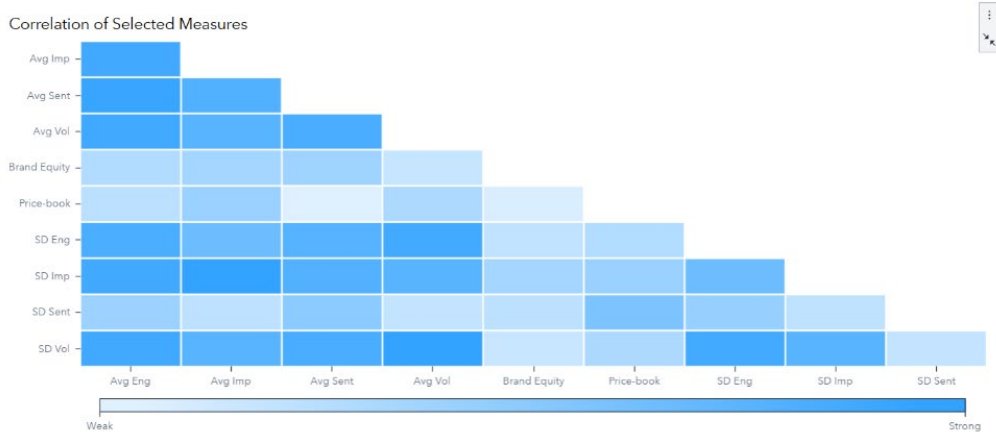


Figure 1: Auto Brands Correlation Matrix



**Figure 2: Information Technology Brands Correlation Matrix**

We also ran neural network modeling on all the variations. Given the apparent collinearity in the model, neural networks are a good technique to establish the combined predictive power of all the variables. But we don't know the specific contribution of each independent variable, those specifics remain a bit of a black box. But with all variables included, the neural networks obtained Average Squared Errors (ASE) for the automobile brands with price/book ratio (0.01) and brand equity (0.02), very low as compared to the ASEs from the regressions. The ASEs for the information tech brands were price/book ratio (0.03) and brand equity (45), similar to the regression results for price/book and somewhat lower for brand equity. Note that neural networks do not generate R<sup>2</sup> values, so ASE is the available tool for comparing results from other models, including regression. ASEs for the regression equations are reported alongside the R<sup>2</sup> values.

Those results are very interesting as they indicate a very high predictive capability of the outcome variables when applying all of the variables. As above, we're not sure of the role of the explanatory variables, but there is clearly a strong connection, especially with the price/book ratio and social media metrics. That result supports the regression analysis and begs for deeper research in the future into the specifics generating the neural network results.

**Table 1: Auto Brands Results**

	Price/Book		Brand Equity	
	R <sup>2</sup> =.668, ASE = 54		R <sup>2</sup> =.275, ASE = 7400	
Parameter	Coefficient	P-Value	Coefficient	P-Value
Intercept	-112.6	0.052	668.9	.168
Impressions	0.000002	0.083		
Sentiment	1.41	0.040	-7.11	.196
Volume	0.0005	0.154	-0.003	.331

**Table 2: Information Technology Brands Regression Results**

	Price/Book		Brand Equity	
	R <sup>2</sup> =.983, ASE = 0.23		R <sup>2</sup> =.378, ASE = 247	
Parameter	Coefficient	P-Value	Coefficient	P-Value
Intercept	-4.16	0.030	3.63	0.001
Impressions			-0.001	0.091
Sentiment	0.075	0.020		
Volume			0.18	0.087
Imp Std Dev	0.0002	0.007		
Vol Std Dev	-0.014	0.025		

As for the regression analyses themselves, all the results show some promise but some stronger than others. For the consumer goods, the automobile brands, the price/book equation ( $R^2 = .668$ ) is a considerably better predictor than the brand equity equation ( $R^2 = .275$ ). Both equations show some explanatory power in the volume and sentiment variables, with the impressions variable also significant in the stronger equation. More specifically, in the brand equity equation, volume and sentiment are not technically significant, above even the relaxed 90% confidence level given the P-values but are the strongest predictors. In the better fitting equation, price/book ratio, sentiment is significant at the 95% level, impressions at 90%, and volume around 85%. There is some stability present in the price/book predictor with the intercept also significant at 95%, but what movement there is in the outcome variable, it can be fairly well-explained by the social media variables.

The B2B IT brands equations are both stronger, particularly the price/book predictor. For brand equity,  $R^2$  comes in at .378 and the impressions and volume variables significant at the 90% level according to the P-values. Note the impressions variable is negative but that may be a function of the colinearity we expect in the equation. The price/book ratio is a very strong result ( $R^2 = .983$ ) with highly significant explanatory variables in impressions standard deviation (99% confidence), volume standard deviation (>95%) and sentiment (>95%), though do note the volume SD coefficient is again negative. That equation is the only one in the group that found the standard deviation or consistency of any of the variables to be a significant input, interesting because social media metric stability was one of the characteristics that had noticeably stood out in some of the previous work. It is apparent here in the most impressive result, so perhaps that characteristic still holds true.

This study was designed to take a closer look at larger datasets than previous work, in multiple industries, and with an alternative metric for brand equity/relational capital. The results are quite interesting and additional depth of analysis is available and can be included in the conference presentation and further work. Initially, the larger dataset continues to provide support to the idea that social media metrics can predict the value of a firm's brand or relational capital. The methodology is backed by very large numbers (some impression numbers include billions of observations per week), but the actual data gathering does still have limitations, including only 9 and 10 brands, respectively. Even so, as we continue to increase the number of firms and brands included, the approach continues to confirm a relationship exists that can be further explored.

The relationship is apparent in two very diverse industries, the consumer-based auto industry and the more B2B-focused information technology brands included here. While one might expect brands and social media to be more associated with consumer goods and services, both industries show promise in predicted brand equity/relational capital. Somewhat surprisingly, better results were actually obtained in the B2B sector, suggesting that the interpretation of brand value as a series of successful interactions with customers and users is correct. The metrics, even though social media, do reflect concrete views and opinions, making their predictive power concerning firms' success in managing intangible assets more convincing.

Finally, the price/book ratio was by far the more accurately predicted outcome variable for both industries. As mentioned at the beginning, this is very positive and raises interesting questions. Initially, price/book is available for just about any publicly listed company, allowing a substantial increase in the available firms/brands to study. Moreover, though a single annual number is reported in widely used data sources, it could conceivably be recalculated on a weekly or even daily basis as stock price changes. Consequently, monthly/weekly/daily social media metrics could be compared with matching price/book values. The actual moves of social media data and this impact could be assessed on a much more granular basis.

Further, the questions posed concerning whether price/book is a metric for all intellectual capital rather than just relational capital is less of a problem than an opportunity. Being able to minutely assess the impact of social media as an accurate predictor of a firm's full IC standing would be valuable in and of itself. If we don't need to limit analysis to relational capital, that's not necessarily a problem. And to the extent that relational capital may be becoming a larger component of intellectual capital is something that could be explored as the metric is applied.

#### **4. Conclusions**

This study expands work on using objective, readily available social media data to predict levels of brand value or, by extension, intellectual capital. While earlier work focused solely on brand equity or relational capital, this effort brings in a potentially broader metric encompassing relational capital but more specifically related to overall intellectual capital.

While the field is teeming with methodologies for measuring intellectual capital or knowledge assets, many are firm-specific and so hard to gather for a substantial multi-firm sample. Alternatively, others are based on

subjective self-report surveys which, although valid, also have their limitations. Social media metrics are readily available, objective, and can be gathered in enormous, big-data-enabled samples.

The study demonstrated considerable potential for using social media metrics including volume, impressions, engagement, and sentiment in two very diverse industries, both consumer and business-to-business. The results also showed some validity in both IC metrics, brand equity and price/book ratio, with the newer ratio variable demonstrating particular strength. A further extension using an AI neural network tool confirmed the predictive power of the variables.

Future work can take this methodology into much bigger data sets as the price/book variable opens many more potential brands for analysis and allows more granular study of changes in the social media and IC relationship over time. Understanding what contributes to more effective use of knowledge assets and the value of intellectual capital can markedly enhance the prospects of the KM and IC disciplines.

**AI and Ethics Declaration:** The research involved no human subjects but only aggregate data collected from publicly available social media platforms. No AI tools were used at any stage of the paper's development.

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