Natural Experiments and Causation in Strategy Research

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Abstract: Research to inform organizational strategy decisions studies the impact of specific managerial decisions on performance. While links from decisions to outcomes can be convincingly identified in individual, specific circumstances, trying to do the same with a larger set of decisions and outcomes can be problematic. In a situation with a substantive sample, relying on standard metrics such as financial statements, the link to particular outcomes can be difficult to establish. Especially when trying to choose metrics not already correlated in some way. Our research is generally in the field of knowledge management (KM). The discipline has an extensive history of attempts to link better management of knowledge and other intangibles to performance outcomes. While the performance outcomes are fairly straightforward (financial success such as profitability or return on investment, innovation success, etc.), the metric for knowledge management is harder to pin down. The literature shows dozens of approaches. Some are for single firms or a small sample, but even if focusing only on metrics for a larger sample of firms, disagreement exists. But even when a KM metric is chosen for a larger sample, there is often a direct tie between input and output measures, making correlation difficult to establish, let alone causation. If profitability is part of both the input and output measures, of course they are correlated. The most advanced statistical techniques don't establish anything more than what the researcher should already know from a cursory look at the logic of the study and the specifics of the variables. As a result, whether KM actually results in better organizational performance is still an open and much debated question in the field. One research approach that can get around this issue is the natural experiment. Pioneered by Nobel winner David Card and others, the natural experiment uses two measurements with a clear, consequential event separating the two—minimizing the impact of samples that might otherwise be connected contemporaneously. The event, such as a change in law, provides a change in circumstances delinking the measures. Whether structured as a pre/post experiment (measuring before or after the intervening event) or control/experimental group experiment (one group exposed to the event, the other not), the outcome can provide convincing results and can even suggest causation. This paper will cover our work with natural experiments in relation to KM and performance outcomes for merger and acquisition (M&A) activity. Can KM metrics before an M&A event predict the success of the event? Success can be defined by the change in financial performance after the event takes place.

Keywords: Knowledge management, Financial performance, Tobin's q, Merger and acquisition, Natural experiments

1. Background

Knowledge management (KM) as a discipline, and the companion field of intellectual capital (IC) are founded on the belief that better management of intangibles such as knowledge assets can lead to superior organizational performance. According to the resource-based view of the firm, defensible competitive advantage comes from singular, hard-to-copy resources (Barney, 1991; Wernerfelt, 1984), and the unique knowledge held by organizational members is particularly distinctive and appropriable. If it can be managed more effectively, organizations can benefit (Zack, 1999; Grant, 1996). Superior KM should lead to superior organizational performance (Chan, 2009).

But one of the ongoing issues in the field is an inability to convincingly demonstrate the link between better management of knowledge or intellectual capital (call them knowledge assets for this paper). Multiple attempts have been made. Many current studies, especially those using structural equation modelling rely on self-report surveys (e.g. Kucharska & Erickson, 2023). While valid and reliable, as far as they go, these methods generally include a sample of respondents from a limited number of organizations, and they report on their perception of knowledge management and organizational performance (financial, innovation, sustainability). As with case studies, these subjective approaches are hard to extend to a wider population—even given broad claims concerning variable significance and model fit.

More objective measures exist, of course, focusing on financial statements and similar reports filed by firms Sveiby, 2010). These measures also have the advantage of allowing sizable samples and straightforward comparisons across organizations in the samples. As such they are reliable, valid, and can be statistically extendable to a wider population. The Sveiby compilation points out the range of methods for measuring knowledge assets, and Tan, et. al. (2003) had earlier noted the lack of agreement over which should be the independent variable representing knowledge when trying to establish a relationship to financial performance in particular.

One tool employed in a number of these types of studies over the past twenty years is Pulic's (2000) Value-Added Intellectual Coefficient (VAIC). The Tan, Plowman and Hancock (2003) just mentioned used it after reviewing the available options. Other important work (Chen, Cheng & Hwang, 2005; Firer & Williams, 2003) also applied VAIC. The metric is readily available from financial statements, is objective, and is easy compare across firms, industries, and regions. VAIC looks at the value-added to a firm compared to its concrete physical assets. As investments in human resources are added to the calculations, the specific value-added from human capital can be inferred, with the remaining value-added attributed to structural capital. As the conceptual framework of intellectual capital (knowledge assets) includes human capital (what employees know about their job), structural capital (knowledge embedded in the firm itself), and relational capital (knowledge about customers) (Bontis, 1999; Edvinsson & Malone, 1997), VAIC is able to separate out an estimate of human and structural capital as well as the overall value of knowledge assets. As such, it has been a popular methodology for studies evaluating the relationship between intellectual capital/knowledge assets and financial performance (Maditinous, et. al., 2011; Smith & Das, 2018; Bayraktaroglu, Calisir & Baskak, 2019).

Besides not including the relational capital aspect (increasingly important in an age when customer data and relationships are ever more prevalent), VAIC has come in for some pointed critiques concerning the makeup of the other individual components and issues such as whether time lags should be included (Andriessen 2004; Ståhle, Ståhle & Aho, 2011, Marzo, 2021). But the technique continues to be used when researchers in the field want a broad, objective sample, and recent enhancements in the approach (defining the components more precisely and employing as a strategy aid rather than a performance p) allow it to continue to maintain its position as a popular option (Nadeem, Dumay & Massaro, 2019; Nazari & Herremans, 2007).

A related option is Tobin's q (Tobin & Brainard, 1977), also assessing value added but without the individual components. It simply looks at the value of the firm compared to the value of its physical assets. The difference or ratio is inferred to be the value of intangible knowledge assets. Any issues with component estimation are removed though the results are, therefore, more general. But a rough estimate of a firm's efficiency in employing physical estimates does allow direct, objective comparisons across industries and across organizations (Erickson & Rothberg, 2017; 2016; 2012).

2. Methodological Issues

Even given the relative advantages of applying such methodologies (objective data rather than subjective perceptions, easy application across a broad sample), important questions remain when trying to use them in establishing a link between better management of knowledge assets and organizational performance. Initially, even with better data, comparing the independent knowledge assets variable with the dependent performance outcome variable is only a statistical technique. Correlation can be inferred but not causation. And even correlation is an iffy prospect given the lack of uniformity in results across the key studies noted (and others). Sometimes the relationship appears clear and sometimes it doesn't.

But even if one buys a relationship has been established, a very basic problem remains with the definitions of the input and output variables. The time lag arguments start to get to it—when does improved performance in managing knowledge assets have an impact on organizational performance, particularly financial results? Immediately? In a year? Two years? One can run different lags and look for the best model results, but that needs some support in theory. And a "definitive" lag has yet to be established (Goebel, 2015).

Needing to clarify lags and whether the input variable has an impact on the outcome variable is necessary because of that variable definition conundrum. Consider the case of Tobin's q (VAIC is similar). The Tobin's q measure of intangible/knowledge assets is some variation of market capitalization to physical assets (book, replacement value, etc.). Market capitalization is the firm's value, (stock price) x (# shares), but stock price comes from the market's assessment of the firm's future potential based on available information such as profitability, ROI/ROE/ROA, and other data used by analysts and stock buyers in making investment decisions. Financial performance can be measured in multiple ways as well, but generally comes down to much of the same data: profitability, ROI/ROE/ROA, etc. In a nutshell, the equation can be represented as:

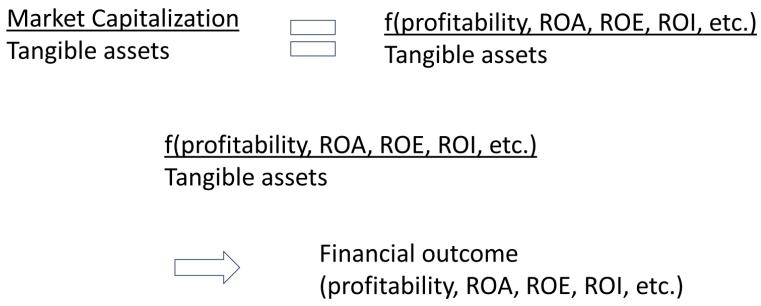

Figure 1: Tautology of many approaches

The result is that the same term or something closely related to it is present in the numerator on both sides of the equation. That makes all attempts at correlation somewhat questionable as the independent and dependent variables are related by definition. The suggested correlation is tautological. Lagging properly can somewhat help as the two terms come from different times but depending on circumstances (and lacking any substantive change in circumstances), the definitional problem may persist. And, in the end, a statistical relationship would never establish causation, that the knowledge metric actually leads to the superior financial performance.

One solution to this conundrum is to formalize the lag by ensuring a change in circumstances, then measuring before and after financial performance results. This approach represents experimentation, where a single identified variable is changed, then its impact on a different variable can be inferred and measured, provided other potential explanatory variables remain constant. Experiments remain the only way to truly establish causation (Campbell & Stanley, 1963; Hair, et al., 2010). While experiments can be difficult in the real world, especially for complex systems like competitive industries and resident firms, newer methods are available, and researchers in business can apply them.

Natural experiments are field experiments conducted against the backdrop of some demonstrable change in circumstances. David Card's 2021 Nobel Prize chiefly related to his work with natural experiments. In his case, he often looked at environmental changes in laws (minimum wage law enacted in New Jersey but not Pennsylvania (Card & Krueger, 1993), life choices like education (Card, 1999), social phenomena such as immigration (Card, 2001). The impact of such changes on wages, income, and other such economic outcomes could be tracked by taking measures in the experimental group (e.g. New Jersey) and the control group (Pennsylvania) and then comparing. Or by taking pre/post measures and assessing the differences.

Classic experiments work because the investigator can control all variables except one, change that variable, and then the only possible inference for any changes in an outcome variable will be that single alteration. In the laboratory, such procedures are fairly straightforward, with conditions carefully controlled and the experimental variable manipulated as desired. Lab experiments tend to have high internal validity (confidence in how the variables are handled and measured) but lower external validity, as results may be hard to extend to messier, real-world conditions outside the laboratory. Field experiments, on the other hand, are generally based on the experimenter manipulating some real-world variable (e.g. exposing individuals to some prompt), then observing the results. All other variables are not carefully controlled, there can be an assumption they remain roughly stable, so internal validity is less. But the external validity is higher as these are obviously real-world conditions. And if repeated in multiple scenarios, field experiments tend to wash out any particular issues with the impact of the uncontrolled circumstantial variables (Erickson, 2017).

Natural experiments have evolved into an important tool for studying large-scale impacts of real-world variables such as policy changes, public health interventions, or other key events. Critically, the quasi-experimental framework allows attribution of causality. The researcher does not have control over the intervention or the circumstances, but is an outside observer (Craig, et. al., 2012). Based on the data available, the researcher can apply a natural experiment methodology, evaluating the impact of the intervention. A wealth of experimental design options is available, depending on when data are available, when the intervention occurs, and other considerations (Leatherdale, 2019). Pre-measures, post-measures, multiple longitudinal measures, multiple groups, and similar options can work with a properly constructed quasi-experimental design.

How knowledge is related to performance outcomes remains a critical aspect of the work everyone in KM and IC does. If managing knowledge better doesn't matter, why invest in doing it? A gap remains in the literature concerning the knowledge/performance relationship. Metrics have been established but continue to have issues with definition and independence (tautology). Studies conducted across industries have also tended to include contemporaneous variables, are often subjective self-reports, and are analysed only by statistical means. They are limited to showing a statistical relationship between knowledge and performance. And results from key studies have been varied. Some show a relationship, some not (Mention, 2012). An opportunity remains to establish the knowledge/performance outcome relationship more convincingly. Especially if some degree of causality can be attached.

3. Natural Experiments and Knowledge Management

In applying a natural experiment methodology to knowledge management outcomes, we identified a key event that can change the prospects of a firm, a merger and acquisition (M&A) action. M&A financial results are famously hard to predict with an overwhelming majority *not* contributing to shareholder value (Marks, Mirvis & Ashkenas, 2017; Christensen, et. al., 2011). Many, many studies, principally in the finance literature have looked to find ways to identify before the fact the M&As that would engender positive outcomes rather than negative (Marks, Mirvis & Ashkenas, 2017; Christensen, et. al., 2011). One review identified 48 studies totalling 46 outcome metrics and 125 possible predictor variables (Das & Kapil, 2012). Finding an accurate predictor of M&A success is something of a holy grail in investing circles (Langford & Brown, 2004).

Attempting to predict a post-M&A outcome with an identifiable variable is an attractive scenario for a natural experiment approach. And knowledge asset level might be an appropriate predictor variable. Both tangible and intangible variables have been identified as drivers of M&A actions (Lev, 2004), but intangibles are more likely to be the more critical and less easy to explain in terms of impact (Sullivan & Sullivan, 2000; Lemieux & Banks, 2007). Tangible assets can be obtained in a number of ways not requiring M&A, but intangibles or knowledge assets are unique and likely to be of high value if related to competitive advantage, and so of interest in a merger or acquisition. Further, given the high aspirations and expense of many M&A events, they are often related to competitive advantage and top-level results (Marks & Mirvis, 2011; Papadakis, 2005) and so acquired assets, tangible and intangible, have a conceptual basis for being considered a potential factor in the financial outcome.

More specifically, if the target in an M&A action has unique, valuable knowledge assets, the acquirer will have intentions to combine it with its own knowledge and grow it. In fact, one could suggest that successful M&A comes from the combined entity better managing the combined knowledge—that one of the parties knows something that will improve the application of knowledge. And given prior metrics on which entity better manages knowledge, how the knowledge is employed and by whom is predictable.

From this perspective, a natural experiment can be constructed. The structure is a pre/post experimental design, recognized in the traditional literature (Campbell & Stanley,1962) and the natural experiment literature (Leatherdale, 2019). Here, knowledge asset efficiency is calculated for acquirer and target at announcement of the M&A (most recent financial reports), using a form of Tobin's q (Tq), market capitalization to tangible assets. Knowledge asset efficiency is also calculated for the combined entity as the M&A is completed. These metrics are used to predict the financial outcome as combined Tq > previous averaged Tq shows the market expects improved financial performance. Stock value at M&A completion vs. stock value at some future time (e.g. 1 year) would show whether the knowledge metric can accurately predict an increase. Or, in the language of Figure 2, the Tq (knowledge assets) metric assigns each M&A announcement to a group: invest or not. Each is judged by data collection (stock price) pre- and post-merger completion (both actually have an intervention). The intervention group is expected to see superior financial returns compared to the control group. Further, one could also posit a control group with no M&A action (no intervention) and track market returns over the relevant period for comparison.

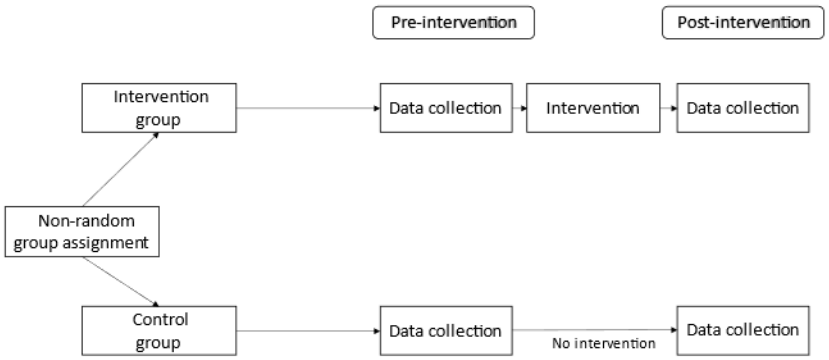

Figure 2: Natural Experiment Design (from Leatherdale, 2019)

Using this basic format, we collected data on multiple experiments, a backstudy, a forward study, and then from a startup investment firm trying the strategy with real capital.

- The backstudy, of almost 2,000 M&A actions on North American exchanges from 2003-2013, showed convincingly superior results for M&A events meeting the criteria. The intervention group predicting the acquirer would improve the knowledge metric of the combined firm showed a 19.5% return. The intervention group not predicting combined improvement had a loss of -0.02%. The non-intervention group, the broader Russell 3000 exchange without M&A provided an 11%) return (Erickson & Rothberg 2023).
- The forward study looked at five chosen M&A events in real time in 2014/2015. Four of the five showed a positive return, much better than the traditional success seen in M&A investments.
- Results from the investment startup are still being processed, but over five years, full capital investments were returned to all participants, showing the strategy more than broke even (after subtracting costs and taxes), again a superior result to what is typically found with M&A actions.

In short, knowledge asset levels in acquirer and target provide some guidance as to the likely intentions of the M&A action. When the acquirer is higher and expected to improve the knowledge performance of the target, good things are expected and can be tested post-merger. Our initial results substantiate this expectation, better knowledge management can raise combined organizational performance. When the combination is not necessarily expected to increase combined performance (the target manages knowledge better), that can also be tested. And our initial results bear that conclusion out. Further, M&A results may be able to be more accurately predicted than generic full-market performance results such as the Russell.

The methodology, of course, is easily replicated with readily available financial reports. Any number of variations, including time periods, targeted industries, other countries, and others could be used in similar studies. But as we seek to better establish if and how knowledge management and intellectual capital might be more convincingly tied to financial outcomes, natural experiments provide one interesting path forward.

4. Conclusions

As noted initially, convincingly establishing a link between better management of knowledge assets and organizational performance, especially financial performance, has proved difficult. Even making a case that the two are correlated has had hits and misses, and the methodologies can sometimes leave one wondering if anything is shown beyond what was already known about definitionally related variables.

Applying a different methodology, one that at least infers causality, is a way around this conundrum. Further, multiple applications of the methodology could firmly establish causality as the possible influence of circumstantial variables is eliminated in different analyses. Natural experiments have potential to fill this role.

By identifying a knowledge management metric as a predictor for the outcome of an experiment, it removes the tautological problem of both an independent and dependent variable being related by definition. As the KM

metric assigns M&A actions to groups, predictions are made, and the predictions are then tested with financial performance results based on objective measures at two different points in time with the M&A completion as the natural event changing the operating conditions of the companies. While not a controllable variable as in a true experiment, it is something that identifiably happens to all sample members, providing much the same outcome. As it happens in the field, the natural experiments have strong external validity, made even stronger by repeated applications in different real-world circumstances. Success in different environments also addresses some of the weaknesses about internal validity, either identifying or removing any other potentially biasing variables.

What this approach has done, then, is establish that knowledge management does have a relationship with positive financial outcomes. The first intervention group, with combined knowledge assets expected to grow post-merger, performs better than the second intervention group without the same expectations. The first intervention group also performs better than the wider market, financial returns from all the cases without any intervention at all. If pursued in other applications, confirmation of this outcome would be an important finding for the KM and IC disciplines.

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