Problems and resolutions to future knowledge-based assets reporting

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Abstract

Purpose – The purpose of this paper is to provide a measurement system of knowledge-based assets for graduate students, researchers and practitioners which can help them enhance their understanding of valuation issues.

Design/methodology/approach – Three types of validity are reported to be relevant for the purposes of understanding knowledge-based assets information systems: criterion validity – establishment of a statistical relationship with a knowledge-based information system and productivity; content validity – representation of a specified universe of contents in the knowledge-based information system; construct validity – measurement of knowledge.

Findings – A framework is provided that helps explain why measurement is important in deciding characteristics such as information value, cost, reliability, validity, and bias (random and non-random error) which is germane to the development of an efficient and effective knowledge-based assets information system.

Practical implications – The paper is a very useful source of information for graduate students, researchers and practitioners involved with testing, designing, valuing and/or implementing a knowledge-based information system.

Originality/value – A measurement model is presented that may spark future models that can be implemented, tested and translated into actions in various organizational settings.

Keywords Intangible assets, Measurement, Financial reporting

Paper type Research paper

In today's knowledge-based economy, various industries operate without a traditional capital base, and without traditional tangible assets. Yet these organizations are increasingly the main contributors of value to the global economy. However, issues surrounding the measurement, valuation and future use of knowledge-based assets loom large as we began our trek into the twenty-first millennium. Part of this difficulty rests with the transition from an industrial era to an information/knowledge era (Blair and Wallman, 2001; Lev, 2001; Upton, 2001; Tillquist and Rodgers, 2005).

Management and accounting measurement techniques emerged from the factory, which enabled a more tractable way of identifying, measuring, and valuing labor, material and overhead inputs to be converted into outputs. The tangible nature of these items related to a company's production facilities and its cost were directed to the balance sheet (unexpired costs) or to the income statement (expired costs). Hence, any monies or funds absorbed by an organization could be readily "accounted for" and translated into some value beneficial to primarily creditors and investors decision making processes (Rodgers, 2006). Hence, this mismatch between tangible and intangible indicators has been ignored since the latter tend to be more difficult to

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measure and less reliable. Also, since capital markets are structured to reward financial results consistently, and intangible indicators only rarely.

DiPiazza and Eccles (2002) argued that comparative tangible and intangible information – including the measurement of such key value drivers as intellectual capital, customer churn rate and other metrics, would make it easier to compare the performance of, for example, German and Japanese car manufacturers, or US and British pharmaceutical companies. They further claimed that this information is currently not readily available in Generally Accepted Accounting Principles (GAAP)-driven financial statements.

The coming of the information age highlighted primarily by technological and communication advances especially since the 1991 tipped the scale from tangible assets to knowledge-based assets as drivers of valuation and profitability of companies (Rodgers, 2003). That is, a great deal of the technological and communication advances benefiting companies was indeed "intangible" in nature. In fact, the OECD (1996) reported that 1995 marked the first time when companies serving industry outnumbered those working in industry. Finally, the value of USA gross investments in intangibles has been estimated to be at least a trillion dollars annually (Nakamura, 1999). This investment includes R&D, advertising and marketing, software, financial activities and creative activities of writers, artists and entertainers. Investments in productivity-enhancing changes in business processes, education and employee training are not included.

This research paper presents a measurement scheme for knowledge-based assets that are now beginning to emerge as dominant assets for a company success as an ongoing operation. This measurement model may spark future models that can be implemented, tested and translated into actions in various organizational settings. The terms intangibles, knowledge-based assets, and intellectual capital have been used interchangeably and all three are widely used in the knowledge literature on assets (see Lev, 2001; Rodgers, 2003). The conversion of knowledge (a raw material) into a value substance (a product of knowledge) is known as a knowledge-based asset.

The concept of value in knowledge-based assets has essentially two different meanings. First, it expresses the usefulness of a particular resource or utility. Second, it has the power of purchasing goods or purchasing power. The former is termed "use value" and the latter is termed "exchange value" (Flamholtz, 1985). The role of knowledge in achieving a competitive advantage is becoming an increasingly important management issue in all business and non-business sectors. For example, assets such as information systems, reputation, brands, competencies and knowledge, training, association to networks, represent an increasing share of company value and have become the most critical factors in the competitiveness of many companies. Recent assessments suggest that 50-90 percent of the value created by a firm come, not from management of tangible assets but from management of knowledge-based assets (Sveiby, 1997).

Knowledge-based assets are deemed to be much more than financial or non-financial information. The value does not lie in the information stored but in the knowledge creation that it may be part of (Rodgers, 2003). Leadbeater (2000) advocated that by ignoring knowledge-based assets the results could be:

- Insiders trading risk.
- Higher costs of capital.

- Misallocation of capital due to intangibles over-evaluation.
- Decreased incentives for entrepreneurs and knowledge workers.
- Increased volatility.

First, insiders can profit better by comprehending the knowledge-based assets valuation than outsiders lacking specialist knowledge. Second, companies that are heavily knowledge-based assets based compared to tangible assets based may find it very difficult to borrow money on collateral. Also, knowledge-based assets companies may be confronted with a higher cost of capital since capital markets are less informed about the performance of these companies. Third, without adequate information regarding knowledge-based assets, companies may manipulate perceptions resulting to over-valuation by investors. Fourth, current accounting techniques and rules for knowledge-based assets provide little guidance in rewarding knowledge workers. Therefore, companies may undervalue human capital. Fifth, inadequate disclosure regarding the quality of intangibles may lead to volatile and uncertain capital markets.

These five areas highlight the necessity for a better understanding of reporting standards and rules pertaining to knowledge. That is, inadequate disclosure of intangibles in a knowledge intensive economy can bring about market imperfections. Ordinary investors are disadvantaged as compared to insider traders' special knowledge about intangibles. Knowledge employees' worth may be undervalued by the organization, thereby over compensating managers and shareholders. Cost of capital may be higher for knowledge intensive firms and investors, due to a lack of accounting information, may misallocate their funds into fashionable knowledge-based companies that they do not understand. Volatility makes it very difficult for capital to be efficiently allocated.

While the knowledge-driven economy is developing, our knowledge about the reality of economy is unfortunately decreasing, at the firm level. Further, we are unable to depict certain important relationships as financial accounting methods and official statistics are still heavily based on a pattern dominated by tangible assets. For example, an Ernst & Young (1997) study found that knowledge-based assets criteria comprise, on average 35 percent of the equity investor's portfolio allocation decisions. Further, Ernst & Young (1997) asked institutional investors to analyze and attribute their investment decisions on 16 large-capitalization, mature companies using financial and knowledge assets information. The study found that, on average, 35 percent of the decision was based on such knowledge assets as management credibility, innovativeness, the quality and execution of corporate strategy, and the ability to attract and retain talented people.

However, many firms without a well-defined and operational measurement system find that business, credit, investment, and economic policy decisions are being made in the dark (Deloitte and Touche, 2004). For example, Ernst & Young (1997) found that those companies that began revamping their information systems between one and two years prior to an initial pubic offerings (IPO) have earned significantly higher share returns than those that delayed changes or never instituted them. Thus, the more prepared organizations' information systems were, and the farther in advance of the IPO these changes were instituted, the more successful they were in both financial and non-financial terms.

The measurement of knowledge-based assets is extremely relevant to the role of managers, investors, analysts, auditors etc. as these new techniques have become part of the impetus that is continuing to redefine and enlarge the use of information. By adopting new measurement techniques for these professionals may provide them with the strategic financial leadership to unlock the hidden values that now can be made explicit and by defining new performance measures for knowledge-based organizations.

Problems with knowledge-based assets measurement

Many experts claim that financial results are the end product of a host of external and internal knowledge-based assets metrics (Deloitte and Touche, 2004). Some of the external knowledge-based assets metrics are customer satisfaction, product or service quality, brand strength, relationships with outside stakeholders, and the impact on society and the environment. Internal knowledge-based assets metrics can be listed as the quality of governance, innovation, operational performance, and employee commitment. The measurement of such knowledge-based assets drivers is tools for going beneath the surface in order to understand what is really occurring in an organization. The measurement system is vital in that knowledge-based assets are leading indicators of corporate health, whereas financial results are lagging indicators.

Throughout the years, practitioners and academicians have vacillated whether knowledge-based assets information systems is a measurement discipline or not. For example, in the AAA Committee report on the Foundations of Accounting Measurement (American Accounting Association, 1971) it states:

> There appear to be at least three basic philosophies concerning the relationships between accounting measurement systems and management information systems. The first, often expressed by management scientists, is that accounting is a subset of management information systems ... A second view of accounting suggests that accounting must expand from its conventional scope to include a management information system as well as the external financial reporting functions that accounting has traditionally maintained ... a third approach and view the scope of accounting as somewhere on the continuum between these two views.

The conditions, which entail and are entailed by knowledge-based assets information system being a measurement discipline, are identified by:

- An analysis of modern measurement theory.
- An analysis of the quasi-measurements that organizations perform.

These two issues will be examined in this paper to determine how measurement theory can be applied to future knowledge-based assets information systems. "Measurement" as defined by Stevens (1946), "is the assignment of numbers to objects or events according to rules". This definition carries with it a few loopholes that should be examined. First, the definition does not indicate that measurement is frequently concerned with the assignment of numerals to represent properties of the empirical phenomena, such as the assignment of the numeral 7 to represent the width in yards of a particular object. In addition, the definition places no restrictions on the rules, which can be used in making numerical assignments.

A more satisfactory explanation of measurement is given by Ellis (1966, pp. 39-41):

> Measurement is the assignment of numerals to represent elements or a property of elements in a specified system on the basis of isomorphism or homomorphism existing between one or more empirical relational systems (ERS) and one or more numerical relational systems (NRS).

This definition of measurement overcomes some of the handicaps of the previous objections, and insures that measurements obtained via the various scales will be informative and consistent.

Regulators and the business community have attempted to provide guidelines as to what knowledge-based assets may be recognized. Some comments point to the need for specific technical guidance (FASB, 2003). Still yet we must consider the relevancy of measurement to knowledge-based assets information systems and its proper application.

The process of measurement permeates our daily activities, helps shape our scientific thoughts, and links our communication channels. In short, it establishes our information systems. Our thinking processes attempt a resume or pattern definition that is an order among objects and symbols for similarities and for congruencies (Rodgers, 2006). In measurement theory, patterns are known as relations. Cohen (1957, p. 170) states:

> Relations are the essence of science ... science is not a knowledge of mere particulars, but rather a knowledge of the way in which classes are related. We know that large things are large only by comparing them to other smaller things. We thus establish the relations "greater than" and "less than".

Measurement is often considered to be the most efficient language to use to communicate numerical relations among the attributes of measured objects and events to well specified rules. These rules can be intended to create nominal (classification), ordinal (rank ordering), interval, or ratio type measurements.

Measurement types differ in terms of the empirical relations the numerals are intended to depict and, in turn, the logical transformations and statistics that can be drawn from the measures. The empirical relationships, which are preserved by the relations between the assigned numerals range from classification, for nominal type measurements, to determination of whether one object is actually one-half another, as with ratio type measurements.

The relationships that are preserved by each measurement type are well-defined in formal (mathematical) measure theory, as are the admissible transformations and meaningful statistics associated with each measurement type. The relations that are preserved in the numerical assignments are described in measurement theory by the concept of representation. Admissible transformations are described by the concept of uniqueness, and meaningful statistics are described by the concept of meaningfulness. Carmines and Zeller (1979) argued that:

> ... measurement focuses on the crucial relationship between the empirically grounded indicator(s) – that is, the observable response – and the underlying unobservable concept(s).

When there is a strong connection between the two mentioned ingredients, analysis of empirical indicators can lead to useful inferences about the relationships among the underlying concepts.

Knowledge-based assets information systems involves relating numbers to objects, and whenever numbers are assigned to certain traits on the basis of observation, and then measurements are being taken. However, emphasis should be placed on the desirable qualities of any measuring procedure or instruments.

In knowledge-based assets information systems the assignment of numerals to attributes of objects must first be such that the mapping conforms to reality. In such a situation, the mapping is said to be homomorphic (or isomorphic) to reality. Theoretically, there must be a homomorphic mapping in order to create measurement scale and, accordingly, representation, uniqueness, and meaningfulness.

In organizational practices, determining whether a mapping is indeed homomorphic is easier said than done. For example, if we are trying to fix a value on the "goodwill" asset of a company. The difficulty arises because in many cases it is extremely difficult to identify the "true" empirical relations. Since the problem of assessing homomorphism arises in empirical and behavioral settings, we might turn to behavioral measurement theory for additional criteria. Generally, we can assume a homomorphic mapping if the measures meet the tests of validity and reliability.

Fundamentally, reliability concerns the extent to which an experiment, test, or any measuring procedure yields the same results on repeated trials. The measurement of any phenomenon always contains a certain amount of chance error. Stanley (1971) observed:

> The amount of chance error may be large or small, but it is universally present to some extent. Two sets of measurement of the same features of the same individuals will never exactly duplicate each other.

The amount of random error is inversely related to the degree of reliability of the measuring instrument. Any measuring instrument is relatively reliable if it is minimally affected by chance disturbances (i.e. random measurement error). Reliability focuses on a particular property of empirical indicators. This concept can be widely recognized in knowledge-based assets information systems by the principle of objectivity.

Validity, which is the heart of behavioral measurement, is the extent to which any measuring instrument measures what it is intended to measure. For example, one might ask, is the net worth of a particular company a valid surrogate for its liquidation value. Cronbach (1971) stated:

> One validates, not a test, but an interpretation of data arising from a specified procedure.

Thus, one validates not the measuring instrument itself but the measuring instrument in relation to the purpose for which it is being used.

Nonrandom error lies at the very heart of validity. As Althauser and Heberlein (1970) observed:

> Matters of validity arise when other factors – more than one underlying construct or methods factors or other unmeasured variables – are seen to affect the measures in addition to one underlying concept and random error.

There are three types of validity that are relevant for the purposes of understanding their relationship to knowledge-based assets information systems. Nunnally (1978) discusses the three major functions of validity as follows:

(1) *Criterion validity* – establishment of a statistical relationship with a particular variable (e.g. SAT test scores predicting the academic success in college).

(2) *Content validity* – representation of a specified universe of contents (e.g. a fourth grade-spelling test).

(3) *Construct validity* – measurement of psychological traits (e.g. a measure of anxiety).

The validity classification can be applied to knowledge-based assets when they are broken into three components:

(1) Knowledge-based assets that can be owned and sold;

(2) Knowledge-based assets that can be controlled but not separated out and sold, and

(3) Knowledge-based assets that may not be wholly controlled by the firm (Blair and Wallman, 2001).

Component A (criterion validity) comprises intellectual property, contracts and business agreements, licenses and franchise rights, quotas and resource allocations (airport landing rights, water rights) and employment contracts. *Component B* (content validity) consists of those areas propriety to a specific company; however, difficult to separate from the continuing operations, such as business secrets, in-process R&D and business processes. *Component C* (construct validity) encompasses items often depicted as human capital, core competencies, as well as organizational image, capital and relationships.

Objectivity is a prerequisite for reliability, but objectivity in itself does not guarantee reliability. Reliability is a prerequisite for validity, but reliability in itself does not guarantee validity. Validity, on the other hand, is generally sufficient to provide a homomorphic mapping. A homomorphic mapping creates a valid measurement scale, which may be characterized as nominal, ordinal, interval, or ratio. Each measurement scale, in turn, has unique characteristics as to representation, uniqueness, and meaningfulness.

After laying down the ground rules for measurement theory, it is now time to determine how these concepts can aid organizations in their daily decision activities. Mock (1975) discussed how important measurement concepts are in three areas of knowledge-based assets information systems. First, much of the information that is collected, processed, stored and communicated by an organization's formal information system are measures of some sort.

Second, measures as to the characteristics of the information system are essential. For example, as many business information systems are computerized, measures such as CPU (Central Processing Unit) times, connect times, cost per memory unit and number of jobs processed has become important in the system selection decisions. Third, those involved with the design and management of knowledge-based assets systems are interested with measuring the components of the output of that system, which is information.

The transformation of knowledge into the end product is a very important process. As with traditional goods, there may be a number of intermediate knowledge-based asset stages, each with their own value. That is, an organization can value and report on these knowledge-based assets in process. This view emphasizes on ways to

promote, motivate, encourage, nurture, and value the knowledge process. In addition, a process may be a knowledge-based asset if it provides or creates for an organization best practices, company standards, R&D material, etc. For example, the use of information technology may help assist organizations to communicate knowledge through e-mail, real-time chat and web awareness tools, video-conferencing, workflow management systems, systems for the distributed authoring of hypertext documents, group-decision support systems, etc.

Future reporting measurement frameworks

Knowledge-based assets information system measurements can be viewed in terms of three general approaches for business reporting (Jarboe, 2005). First, the current balance sheet statement can include knowledge-based assets for reporting purposes. Second, reporting performance measures and metrics of intangibles (such as customer satisfaction, product or service quality, brand strength) can be included in a separate section of the financial statements. Third, a report can contain a value-creation model that ties various process metrics with future financial performance.

The first approach can include knowledge-based assets along with the traditional assets as prescribed by a regulatory body. This approach allows investors and creditors to assess whether the knowledge-based assets values are increasing or decreasing over time when compared with other traditional assets.

The second approach in today's service and knowledge economy provides that performance metrics take into account the changing definition of success (customer experience, not just price and product differentiation, for one).

The third approach of value creation can be viewed in the following manner. For the customer, the metric measurements relate to products and providing services that customers find consistently useful. In today's knowledge economy, such value creation is based primarily on product and process innovation and on understanding unique customer needs with ever-increasing speed and precision.

In addition, the measurement of how organization employees' commitment, energy, and imagination can innovate and deliver outstanding service is an important value creation indicator. That is, value must therefore be created for those employees in order to motivate and enable them. Value for employees includes being treated respectfully and being involved in decision-making. Related indicators include employees' compensation opportunities and their continued training and development. Creating value for investors means delivering consistently high returns on their invested capital. This generally relates to strong revenue growth and profit margins. These, in turn, can be achieved only if a firm delivers sustained value for customers.

When investors buy shares in a company, or when customers enter into a relationship with a company, they are not basing their associations on a particular product or set of products. Rather, both constituencies are expressing their belief that the organization will continue to develop processes that allow it to take advantage of emerging technologies and changing market needs to create useful, profitable products and services. That capability to develop resources and effectively match them with opportunities is the core of any efficient organization's value to customers, and the basis of its valuation by shareholders. That value-creation process is, in turn, assembled on the capabilities and motivation of the organization's employees.

Conclusion

While clearly recognizing the importance of knowledge-based assets many executives struggle to define what should be measured. Corporate leaders also see that their organizations have a long road to travel in order to manage, measure, and report on the performance of these assets accurately. And while the impact of intangibles on market valuations is still to be determined, the overall perception is that successful companies proactively manage knowledge-based assets; employ measurement systems to track intangibles' performance. Hence, current research indicates that knowledge-based assets are measurable. As long as knowledge-based assets are relevant and timely, it should assist investors to assess a firm's potential for future earnings as well as keeping share prices stable. This can allow for a reduction of risks associated with a firm and results in a lower cost of capital. The present dispute is deciding on which model to rely on, and moreover, which model to use as a standard measurement.

The problem with measuring knowledge-based assets is that such measurements are too specific to an industry and perhaps to a particular entity. Research yields plenty of data showing how measurements can be conjured up to measure certain intangible events. Therefore, an understanding of measurement is important in deciding characteristics such as information value, cost, reliability, validity, and bias (random and non-random error) which is germane to the development of an efficient and effective knowledge-based assets information system.

In summary, this paper highlights the evolutionary change from an industrial age financial statement reporting to an information age financial and knowledge-based asset statement reporting. The fundamental law of diminishing returns for tangible assets may be replaced by the new manifestation of increasing returns for intangibles. Undoubtedly this change is motivated by information technology influencing the complexity in production processes and products. Without accountants, managers, investment bankers, and regulators taking a participative lead in the measurement and valuation of knowledge-based assets, the following problems will persist:

- Insiders trading risk.
- Higher costs of capital.
- Misallocation of capital due to intangibles over-evaluation.
- Decreased incentives for entrepreneurs and knowledge workers.
- Increased market volatility.

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