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Measuring strategic value-drivers for managing intellectual capital

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Abstract *In an evolving business environment characterised by globalisation and a challenging competitive paradigm, it is imperative for strategic management processes to focus on the financial perspectives of value and risk in intellectual capital to create sustainability in long-term value. This paper presents the key issues pertaining to the strategic management of value and risk in intellectual capital and presents some hypotheses for a strategic management framework based on identified underlying value-drivers, which in turn helps to focus and address the issue of risk management more adequately. The pervasive value-drivers in three intellectual capital-intensive sectors in Australia are identified from an analysis of case studies, then specified and extrapolated to provide implications for the strategic management of value and risk in the knowledge-based firms. The strategic management implications of these value-drivers are discussed and explained.*

Introduction

It has long been recognised that technological innovation and economic growth are inextricably linked (Scherer, 1999; Solow, 1957). This has led to the recent phalanx of technological investments that has contributed to the rapid growth in value of knowledge-based firms in industrialised countries. This market phenomenon has created a situation that impels management to acquire a comprehensive knowledge of the value creation capacity of intellectual endeavours and the necessary strategic management tools and processes to maintain competitiveness. Invariably, with new wealth creation opportunities come new risks and the maximisation of owners' value entails the minimisation of risk. The pursuit of processes that comprise the means of creating long-term shareholder value lies at the heart of strategic management, together with the choices made in designing and using the strategic management process. These processes are as much involved with understanding and managing the new competitive arena, as it is with making the right investments in intellectual capital, and managing the risks associated with operating in the knowledge economy. Firms are in competition with one another, and they must make investments in intellectual capital, not merely to remain competitive, but to achieve above-average returns for shareholders.

The knowledge economy has presented two distinct characteristics – globalisation, which has greatly expanded the boundaries of the competitive arena, and the need by firms to view intellectual capital as a key organisational asset. With the rapid growth of the global knowledge economy, intellectual capital of a firm has emerged as a valuable source of sustainable competitive advantage (Hanson *et al.*, 2002), and become a critical driver of profitability, and long-term value creation.

The strategic direction of firms must therefore shift from maximising the utilisation of the tangible asset base of the firm, to the effective management of, and leveraging on, intellectual capital. Here, the ability to remain competitive and harness the market

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opportunities that globalisation offers, will depend on the manner by which firms invest, value and manage the risk-return relationship of the firm's intellectual capital assets.

Strategic management of intellectual capital: critical financial management perspectives

Value and valuation models of intellectual capital

The primary objective of management in maximizing shareholders' value is straightforward and generally involves generating consistently high returns with regular growth. The process of valuation refers to activities such as techniques, procedures and statistical tools that are employed by management and market analysts to estimate the economic value of an asset. The modern evolving economic environment is one where intellectual capital is regarded as a key organisational asset, albeit one that is tacit and intangible. Intellectual capital (Bontis, 1996, 1998, 1999, 2001, 2003), like its tangible counterpart, is used by firms to generate and exploit in the creation and sustenance of wealth, and in this respect a shift is appearing on how the valuation game is played out (Razgaitis, 1999; Smith and Parr, 2000). Valuation is central to the financial management function of a business, which encompasses the daily administrative financial and strategic capital budgeting decision-making processes. While this has always been regarded as a difficult area of decision-making, the emergence of the knowledge economy has presented firms with a different and even more onerous environment for valuation of intellectual capital and, by extension, the strategic management of value. Therefore, in order to manage performance, management must possess the ability to understand the underlying value of knowledge to efficiently and effectively make continuous investments in intellectual capital. Further, in the present competitive global environment, the ability to value and make investments in intellectual capital projects provides a substantial source of competitive advantage and enables firms to benefit from increasing returns (Arthur, 1996) from those investments.

The valuation process is fundamentally important, primarily because it is a necessary basis for business investments to occur. From a risk management perspective, Ittner (1998) stated that "if you use the wrong measure, or if it doesn't map to economic performance, not only have you wasted a lot of money... but you've also potentially made disastrous... decisions". For instance, a majority of firms use the traditional methods for valuing intellectual capital and the discount rate is an important estimate used in the discounted cash flow (DCF) models and a proper estimate of this rate for application in valuation models is important to reflect the underlying characteristics of the business and market conditions. It is quite obvious that without appropriate valuation tools, capital investments in intellectual capital could not take place in an environment in which knowledge could not be developed into effective, income producing products and services, and ensure a continuing stream of cash flow in the future.

In strategic management of investments in intellectual capital, where either the investments are relatively early stage, or where there is no history of cash flows emanating from similar investments in the past, the assumptions behind the DCF system may be less appropriate. Furthermore, the DCF method does not recognise the value of a wide range of competitive commitments and the commitments to innovate in advance of the competition (Narayanan, 2001). The traditional valuation models have

revealed limitations (Dabek, 1999; Drucker, 1993; Razgaitis, 1999) when used for measuring intellectual capital. These limitations make it necessary to explore a different approach to valuation of intellectual capital and possibly from a strategic management perspective. The alternative valuation methods that incorporate strategic management elements are real option pricing and models based on widely accepted econometric techniques such as multifactor and co-integration modelling (Oh and Islam, 2001) for valuing intellectual capital investments. Helfert (2000) proposes another approach that is based on the hypothesis that there are key elements that stand out as significant in the creation of value in intellectual capital assets. Thus, these "value-drivers" represent the source of value of intellectual capital and identifying and understanding their underlying characteristics would allow us to effectively manage the value of the knowledge-based firm.

Value-driver research methodology

In recent exploratory research, a study was carried out on three technology industries – Biotechnology (biotech), Information technology (infotech) and Energy and Environment (E&E) – to determine the presence of underlying value-drivers (Bose and Oh, 2003). Specifically, the research was aimed at:

- identifying and specifying the key factors that drive the value chain of intellectual capital;
- evaluating the pervasiveness of these factors pertaining to the valuation of intellectual capital across the industries; and
- extrapolating their strategic significance, as value-drivers for intellectual capital, in enhancing the value of the firm.

The theoretical and empirical information on the intellectual capital value-drivers in the following sections had been derived from current literature and case studies drawn from three companies, based in a technology park, one from each of the three selected industries. The case study analysis uses the NVIVO software to evaluate the data from the case studies in an attempt to identify the key factors, from an intellectual capital valuation perspective.

The data and results from the case study were further used in a questionnaire survey for extrapolation. The Logit statistical model, which is based on the cumulative distribution function using binary logistical regression, is adopted as the specified model for valuation of the three technology sectors evaluated in this paper. The results from the questionnaire survey are analysed, statistically tested and verified for significance and subsequently, Logit value-driver models (LVM) for the three technology sectors are estimated and statistically tested. The three estimated LVM equations, depicting the pervasiveness of the value-drivers on the firm's value, are presented in the following section.

Logit value-driver models

The specified equation for the biotech LVM is as follows:

$$\text{Log}(Y/(1-Y))_{\text{biotech}} = \underset{(4.75)}{1.247696} + \underset{(8.38)}{0.0930}(\text{value-drivers})_{\text{biotech}} \qquad (1)$$
$$R^2 = 0.46 \;\; \text{DW} = 2.04$$

where, $\text{Log}(Y/(1-Y)_{\text{biotech}}$ is the value of a firm in the biotech sector; and $(\text{value-drivers})_{\text{biotech}}$ is the set of specified value-drivers for the biotech sector.

The specified equation for the infotech LVM is as follows:

$$\text{Log}(Y/(1-Y)_{\text{infotech}} = \underset{(4.43)}{0.976717} + \underset{(8.38)}{0.0837}(\text{value-drivers})_{\text{infotech}} \quad (2)$$

$$R^2 = 0.373 \quad \text{DW} = 2.44$$

where $\text{Log}(Y/(1-Y)_{\text{infotech}}$ is the value of a firm in the infotech sector; and $(\text{value-drivers})_{\text{infotech}}$ is the set of specified value-drivers for the infotech sector.

The specified equation for the E&E LVM is as follows:

$$\text{Log}(Y/(1-Y))_{\text{E\&E}} = \underset{(4.32)}{1.134416} + \underset{(6.63)}{0.1133}(\text{value-drivers})_{\text{E\&E}} \quad (3)$$

$$R^2 = 0.355 \quad \text{DW} = 1.50$$

where, $\text{Log}(Y/(1-Y))_{\text{E\&E}}$ is the value of a firm in the E&E sector; and $(\text{value-drivers})_{\text{E\&E}}$ is the set of specified value-drivers for the E&E sector.

The statistical tests were conducted on the LVMs under the conditions of good-fit specified in Ramanathan (1999) and concluded that the estimated coefficients are unbiased, efficient and consistent. Therefore, the LVMs are representative of the pervasiveness of the value-drivers on the value of firms in their respective technology sectors.

Results and implications for strategic management

Table I depicts the seven most pervasive value-drivers from the study conducted (Bose and Oh, 2003) and they are ranked in order of frequency of observations across all sectors. Table I also shows the importance placed on the value-driver by each sector. The implications of these findings for management are discussed below.

The value-drivers identified to possess strategic management implications are discussed in detail in this section. The highest ranked value-driver is expected "Profitability" of the intellectual asset (with a total of 35 observations across all sectors). Day (1999) states that profitability is a major objective of any business and is the reward for making investments in the past, which is also a strategic step in establishing a firm's competitive position, and intended market share. Its significance in enhancing a firm's value underpins the importance of the commercial viability of

Table I. Comparison of value-drivers in different sectors

Value-driver	Biotech	Infotech	E&E	Total	Ranking
Profitability	16	7	12	35	1
Uniqueness of innovation	11	9	14	34	2
Reputation of research team and firm	6	11	8	25	3
Growth prospects	16	4	4	24	4
Quality of management	11	8	4	23	5
Economic factors	6	7	2	15	6
Risks	6	6	2	14	7

a knowledge-based venture in wealth creation. The perception of profitability for investments in knowledge assets is no different to tangible assets in their role as a vehicle of wealth creation. The objective of achieving profitability is a reflection of the awareness of managers to make commercially viable investments (Anthony *et al.*, 1995; Day, 1999) and intellectual capital arising out of a firm's innovation extends its technological capabilities, and contributes to the wealth of the firm and society (Narayanan, 2001).

The next value-driver is "Uniqueness of an Innovation", with 34 observations. This value-driver implies a firm's creativity, and has a major role to play in the creation of intellectual assets that are genuinely unique as distinct from those that are merely extensions or improvements (Kuratko and Hodgetts, 1998). Most innovations result from a conscious, purposeful search for new opportunities (Josty, 1990). Intellectual assets are a reflection of intellectual capital which are products of innovative thinking, new methods or new knowledge (Drucker, 1985). Further, there is a strong perception that firms in the knowledge economy succeed because they are able to develop range of unique products and services (Karakaya and Kobu, 1994).

The next highest ranked driver is "Reputation of Research Team and Firm" and this high ranking is consistent with the findings of Darby *et al.* (1999). They hypothesised that high-tech ventures with strong link to "star scientists" should be more highly valued by investors and examined the effects of ties to star scientists on the market value for new biotechnology firms. In their conclusions, they stated that an increase in a firm's intellectual capital would lead to higher market valuation.

"Growth Prospects" arising out of commercialising the products of intellectual capital is observed to be the fourth most important value-driver. Growth is derived from a firm's market share, competitive positioning and profitability (Day, 1999). Thus business managers are keenly aware of the need to make the strategic investments to maintain and increase their market share (Kotler *et al.*, 2001). For this reason, firms invest in assets that yield long-term value creation by giving them a strong market position based on superior customer value, or the lowest delivered cost (Narayanan, 2001; Westland, 2002), which in turn, give them the competitive advantages of growth in market share and profitability, both of which are strongly related (Day, 1999).

The other important value-drivers (in descending order) are "Quality of Management" – where successful management involves not merely discovering new solutions or adopting seemingly effective innovations, but also finding a home for the discovered products and services in the marketplace (Day, 1999) and the costs and risks inherent in developing intellectual assets must be issues of careful management consideration (Contractor and Narayanan, 1990; Weil and Cangemi, 1983); quality of management is inherent in human capital, such as key scientists employed in high-tech firms, which have a strategic advantage in exploiting the commercialisation of the discoveries. "Economic Factors" – connotes a strategic evaluation and management of the market conditions to enhance performance.

"Risk" as a value-driver transcends all the value-drivers above even though it has not been ranked as highly. The element of risk in business ventures can be described from the extensive work in portfolio theory and capital market theory by Markowitz (1952) and Sharpe (1964) in that management incorporates risk considerations in making financial decisions.

Correlation of value-drivers between industries

From Table II, the level of correlation of value-drivers between industries seems to be higher for biotechnology and infotech, than for biotechnology and E&E and infotech and E&E.

It can be concluded from this observation that there is a greater degree of cross-over in value management between the biotech and infotech sectors. This can imply a greater degree of similarity in market conditions the two sectors have to confront. These market conditions may pertain to competition, technology, capital risk and return, regulatory frameworks, customer behaviour and so on. The cross-sectional differences can be attributed to varying economic fundamentals that need to be incorporated in industry-specific valuation models.

Implications for strategic management

The implications from the research findings from a strategic management perspective would be to practise prudence in monitoring and evaluating the changes to these pervasive value-drivers in strategic decision-making. There appears to be a distinct agreement among all three sectors on the pervasiveness of the top four value-drivers, being profitability, uniqueness of innovation, reputation of research team and firm and growth prospects. This does not undermine the significance and quality of the other value-drivers but does highlight where management should focus more resources. It is conceivable that value-drivers will change over time due to changes in market conditions.

Risk management and value in intellectual capital

The development of intellectual capital for the foundation of market dominance and continuing profitability of firms has been driven by the rapid growth of intellectual capital. Introducing new intellectual products into the market has its fair share of risk, and may even be considered extremely risky in certain circumstances. Managing the project life cycle from beginning to successful commercialisation of the new product entails difficult decisions that involve risks and determine the future course of the program as well as the firm's future revenue and profitability. This means that it is far more difficult to estimate cash flows, growth and discount rates in the knowledge economy than in more traditional and stable industries.

The common acceptance that all investment is made in an environment of uncertainty and the reward from holding onto an investment is done so for the return the investment is expected to generate. A fundamental principle of finance is that investors require a higher return to bear higher risk. The concept of risk in finance underlies the consequences of undesirable outcomes and their implications to individual investors or firms. The need to understand the nature and source of potential risk is to make effective management decisions to create value for the firm.

Table II.
Correlation of value-drivers between sectors

	Biotech	Infotech	E&E
Biotech	1		
Infotech	0.4843	1	
E&E	0.2697	0.3125	1

The value of the firm is represented by its market value and it is affected by the amount of uncertainty (i.e. risk) in its future cash flows. In this context, risk can be viewed from two perspectives; first the firm-specific or idiosyncratic risk and, second the portion of total risk that cannot be diversified away – the market or systematic risk. The price of risk in the capital market represents that part of total risk that cannot be diversified away. The composition of firm-specific risk to market risk for an intellectual capital-intensive sector was found to have a higher level of unsystematic risk (82 per cent) to systematic risk (18 per cent) for the Australian e-commerce sector (Oh, 2001). For knowledge-based firms to maximise value, it would be crucial to minimise the firm-specific risk level through strategic risk management of the factors that adversely affect the value-drivers.

There is some degree of similarity in venture capital investments and listed small growth firms (Cochrane, 2001) as a large proportion of investments in intellectual capital are made of start-up firms, which do not have the historical performance to list publicly, they are mainly funded by private equity such as venture capital. Private equity required rates of return for such capital are normally high. This is because intellectual capital investments carry more risk compared to most investments and the returns are expected to commensurate with the risk exposure. The equity risk premium used in the discount rate should reflect what investors expect future risk premium for the business and is thus a forward looking concept. The concept of increasing returns from intellectual capital (Arthur, 1996) complicates the calculation of the equity risk premium by the magnitude and timing of the increase.

Risks in intellectual capital valuation

From a valuation perspective, it is important to understand, assess, and incorporate risk into the investment evaluation process as accurately as possible. The ability to eliminate risk, or even avoid it, is very nearly impossible, particularly so in intellectual capital investments because of their characteristic intangibility. In respect of technology valuation, four different categories of operating risk (Razgaitis, 1999) should be observed. First, marketing risks as good intellectual capital projects do not necessarily guarantee commercial viability. What the market will demand and the quantity customers will purchase is often difficult to predict due to the fact that the performance of the product in the market is subject to a multiplicity of marketing risks, not least changing customer tastes and competitors' actions. Secondly, the quality of research and development is a major risk factor in the development and deployment of technology as good ideas do not necessarily ensure commercial success because of uncertainties that may arise in the actual process of "prototyping" the technology. R&D is an expensive and time-consuming process, and while the technology may be workable, costs may make it commercially unviable. The third risk is manufacturability risk, which refers to the ability to position the final manufacturing processes in a cost-effective manner from the R&D efforts. Passing the R&D stage does not necessarily translate to success at the manufacturing stage. The costs of capital equipment, different production modes, and the quality of production personnel are some of the factors that can cause a potentially good technology to fail. Fourth, competitive risk exposure refers to the actions of competitors while a technology is being developed for production. The long time lag it often takes from the "idea" stage to full commercialisation of a technology provides an opportunity to competitors to

accelerate their own efforts to introduce new products, or replace those products that are facing a declining life cycle. Companies cannot be assumed to be silent spectators to competitor actions on new product and services development. Even if a firm introduced new and improved products ahead of its competitors, it does not guarantee commercial success. This is because firms can easily learn from the mistakes of competitors and avoid making costly errors that pioneering often entails.

Risks in value-driver research

In respect of the research conducted on the three knowledge-intensive industries (above), judging from the low observations, it appears that the risk factors inherent in the intellectual ventures are either not a major concern or still not fully understood or acknowledged by the management of the firms. This situation could possibly be due to the lack of appreciation about the full implications of both financial and operational risks that exists in the knowledge-based industries. There is a systematic risk component associated with the cash flows of technology-intensive ventures while the technical risks are idiosyncratic (Berk *et al.*, 1998; Oh, 2001).

The implication for management is that relevant risks affecting the valuation of intellectual capital assets need to be determined and measured in the evaluation process for high-tech firms be they in the form of risk premia earned for firm external factors such as the NASDAQ composite index, level of consumer confidence and foreign exchange rates (Oh, 2001), during development (Berk *et al.*, 1998) or human capital (Darby *et al.*, 1999).

Implications and conclusions

With the advent of the knowledge economy it is imperative for firms to focus on strategic management processes concerned with creating long-term value from intellectual capital. Central to these processes are financial management perspectives of valuation of intellectual capital assets, and the management of their attendant risks. While valuation is necessary for securing investments in intellectual capital assets, risks have to be understood and managed to create wealth.

For purposes of valuation of intellectual capital assets, a new methodology concerned with determining their underlying value-drivers, clearly demonstrates its advantage over other established methodologies. Differences in value-drivers of three different industries show that strategic financial management should not assume the accuracy of valuations based upon methodologies that may be commonly used, but which may be inappropriate in the context of intellectual capital assets.

Like all other commercial ventures, the primary objective of the knowledge-based firm is to maximise its value and hence increase the wealth of its owners, the fundamental financial principle underlying risk – that investors require a higher return to bear risk – needs to be accounted for by taking into consideration the value-drivers in intellectual capital assets and the extent their inherent risks can be managed. In this context, strategic management of firms in the knowledge economy involves understanding and appreciating the nature and source(s) of risk in order to make effective financial decisions and offer a higher chance for the success of the venture.

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