Measuring the Value of Knowledge Resources

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Abstract:

The knowledge-based economy presents a need for knowledge value metrics that are reliable and acceptable to internal and external stakeholders. Researchers have responded with numerous methods which often promise more than they deliver, mainly because they fail to translate value into observable objective criteria. This paper proposes a taxonomy for identifying valuable human capital. Grounded in the intellectual capital literature, the taxonomy is based on tacit human capital, and three new constructs: tacit social capital (organizational memory), tacit structural capital (learning organization contribution), and tacit relational capital (knowledge tied to the individual rather than the position). The taxonomy combines a broad range of extant measurement constructs to develop a valuable human capital index. The index may be used to assess the organisation's overall 'health' in each of the four types of capital, and may also help identify why individuals create value for the organisation.

INTRODUCTION

This paper proposes a conceptual model for the value measurement of knowledge resources. The need for measuring the economic value of knowledge is being driven by the emergence of the knowledge-based economy in the 21st century. The knowledge-based economy places the importance for creating economic value with knowledge. The significance of the changes created by the knowledge economy is illustrated by comparing the 'economics of things' (i.e. the industrial age) and the 'economics of information' (i.e. the knowledge economy). This occurs through the value of connectivity. Whereas the value of tangible goods and services expires once they are consumed, the reverse is true for intangible assets such as knowledge. The value of an idea, invention, company or technology increases exponentially as the number of systems it participates with increases linearly (Kelly, 1998). In other words, the value of knowledge actually increases the more it is used.

The knowledge-based economy presents particular problems for investors, management, customers, and regulators who have a need for knowledge value metrics that are reliable and acceptable to the certifying bodies that have traditionally supplied financial data (Housel and Bell, 2001). Traditional financial statements cannot adequately capture the current or future value of firms in the 21st century. Housel and Bell (2001) explain that the main change in the transition from industrial age (20th century) to the knowledge economy (21st century) has been the way investors assign value to firms. In the industrial age, greater value was placed on the ownership of tangible assets. In the knowledge economy, investors estimate the future value of a firm's present knowledge and knowledge-generating capacity (Housel and Bell, 2001). The nature of this problem is illustrated by market capitalization, which reflects investors' expectations of a firm's ability to generate future earnings. In the knowledge-based economy, traditional, tangible assets such as factories, inventories and property account for a smaller and smaller portion of market capitalization (Kluge, Stein, and Licht, 2001). For example, the market capitalization of IBM has only 23% covered by tangible assets, General Electric has only 14%, while Microsoft has just 1% (Kluge, Stein, and Licht, 2001). The remainder of corporate worth, the difference between book value and market value, is attributed to intangible assets, such as knowledge. Given traditional methods, such as balance sheets, cannot accurately represent the true market value of firms, researchers and practitioners are searching for alternative methods.

Researchers across disciplines have developed a wide range of methods for measuring the economic value of knowledge. In our review of the literature for this paper, we identified twenty (20) different methods (see table 1). There are three problems with these methods. First, it is very difficult to identify

how knowledge contributes to firm performance. Firm performance is causally ambiguous and it is very difficult to know with any certainty what resources create competitive advantage leading to superior performance in an industry (see Priem and Butler, 2001). Second, the majority of the existing methods are either measurements, which do not actually assess value, or value assessments, which are subjective and therefore lack applicability across firms and industry contexts (see Andriesson, 2004). Third, we believe that researchers and practitioners may be measuring the wrong thing! We propose that perhaps firms should not try to identify and measure all knowledge, instead, focusing on the most valuable knowledge. Within this context, we propose a taxonomy for identifying valuable human capital. Grounded in the intellectual capital literature, the taxonomy is based on tacit human capital, and three new constructs: tacit social capital (organizational memory), tacit structural capital (learning organization contribution), and tacit relational capital (knowledge tied to the individual rather than the position). The taxonomy combines a broad range of extant measurement constructs to develop a valuable human capital index. The index may be used to assess the organisation's overall 'health' in each of the four types of capital, and may also help identify why individuals create value for the organisation.

LITERATURE REVIEW

The economic value of knowledge

While there is now widespread acceptance that knowledge has economic value for the firm, there is little consensus on how to measure this. As a result, a wide range of knowledge measurement methods have been developed. Andriesson (2004) identified over 30 methods for valuing or measuring intangible assets. However, many of these methods simply label things differently and are much the same (Bontis, 1998). More importantly, the methods cover such a broad range of different problem categories, that it is difficult to determine their effectiveness as solutions, and impossible to accept that they can do all that the authors claim. For example, three of the better known methods – the Skandia navigator (Edvinsson and Malone, 1997), the intangible asset monitor (Sveiby, 1997), and the intellectual capital index (Roos et al., 1997) – do not measure value at all, despite their intentions (see Andriesson, 2004). They are measurement methods only. Indeed, in his extensive review of the field, Andriesson (2004) found that none of the ten major methods had a value assessment component; and only Kaplan and Norton's (2001) Balanced Scorecard had a value measurement component, but this were designed for improving internal management, not external reporting, which does not help investors. Ideally, we need a method that measures value and also address the need for improved internal management, improved external reporting, and regulatory reporting requirements.

The difference between measurement and valuation

In developing a method to identify the economic value of organisational knowledge, we need first to differentiate between measurement and valuation. As Andriesson (2004) points out, this distinction is not yet understood by the field and the broad range of methods fall under headings such as valuation, financial valuation, measurement, and assessment in a confusing way. Our objective in this paper is to propose a knowledge valuation method, not a measurement framework. Andriesson (2004) explains the difference in this way:

a. Is there a value scale we can use that reflects usefulness or desirability?
b. If yes to (a), is money the unit used on the value scale?
c. If yes to (b), this is financial valuation.
d. If no to (b), can the value be translated into observable criteria?
e. If yes to (d), this is value measurement.
f. If no to (d), this is value assessment.
g. If no to (a), can we observe the variable at hand?
h. If yes to (g), this is measurement.
i. If no to (g), you should exit and not waste your time trying to measure or value.

Our objective is to propose a method for value measurement – (e) above – which uses a non-monetary criterion which may be translated into observable phenomena. The difference between value measurement and value assessment is objectivity. Value assessment depends on personal judgement by the evaluator (see Andriesson, 2004). This subjectivity limits its applicability across industry and firm contexts, which perhaps explains why most of the main methods do not cover value assessment.

Review of existing methods

In our review of the literature, we found several themes which summarise the different approaches to the problem of measuring the value of knowledge resources. These are presented in Table 1. The table summarises each method along three dimensions. First, the problem the method aims to solve. We aggregate the problems into three categories: improving internal management, improving external reporting, and transactional and statutory motives. Second, the type of measurement or valuation involved (see the checklist above). Third, a summary of the method used.

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Table 1 shows that the majority of existing methods do not provide a valuation measurement. This represents a clear gap in the literature which we aim to fill. All of the methods have advantages and disadvantages, however, in our view, the method with the most potential is human resources

accounting (HRA). We feel this way because HRA focuses on human capital. Several researchers argue that human capital is the firm's most important asset because it is the source of creativity and, therefore, innovation, change, and improvement (Carson, et. al. 2004; Bozbura, 2004). Bozbura (2004) provided empirical evidence that there is a positive relationship between the human capital and the book/market value of the firm. This research found that increases in employee capabilities are seen to directly influence financial results, leading to a direct relationship between human capital and organisation performance (Bozbura 2004). HRA models have two further important advantages. They can be calculated as assets in financial terms (Harrison and Sullivan, 2000). It is reasonably easy to trace the cost of human capital through salaries, training, and so on. Firms can also assess the 'value' of employees through tools such as the Hay methodology, which is commonly used to compare and determine salary scales, and as a way to identify high performance and appropriate rewards (Robinson and Kleiner, 1996).

However, the HRA method has three fundamental weaknesses. First, it is subjective and, therefore, a value assessment, rather than valuation measurement. Thus, even though HRA can yield a solid numerical figure of value of intellectual capital, the necessary estimations made while using HRA, can bring about inaccuracies that will lead to false value measures (Bontis, et. al. 1999). Second, human capital is very difficult to define in a single framework, because it consists of a range of qualitative measures, including employees' knowledge acumination, leadership abilities, and risk-taking and problem-solving capabilities (Bozbura 2004). For example, the large amount of assumptions such as the projected company size in the future and the tenure per employee, turnover, and salary increases that the HRA models are based on, is seen as a disadvantage (Bontis, et. al. 1999).Third, HRA values human capital despite the fact that the firm does not explicitly own it (Johnson 2002). Organizations do not own people and employees may leave at any time and take their knowledge with them.

THEORY DEVELOPMENT

In developing a conceptual model of knowledge value measurement, we aimed to disaggregate the knowledge resources at several levels. As with tangible assets, intangible asset value must be broken down into a set of commonly accepted units of measurement. In accounting the unit of measurement is money. This provides a level of detail that enhances the managerial application of the financial statements. For example, investors will want to know the firm's profitability, which may be summarised by one metric, e.g. return-on-investment (ROI), but they will also want further metrics which explain the ROI. In other words, they require an aggregate measure – ROI – to be disaggregated,

using the DuPont Model, into explanatory measures of operating margin and asset turnover. We follow the same approach with knowledge value measurement.

Human capital is the knowledge possessed by employees and may be aggregated at the organizational level in terms of their combined competence and experience (Dess and Shaw, 2001). More specifically, tacit knowledge, i.e. the knowledge in people's heads, is the most valuable knowledge (see Nonaka and Takeuchi, 1995). It is also acknowledged that human capital plays the essential role in creating value for the firm by combining other resources to produce capability (Grant, 1996). We highlighted these points in the literature review section where we identified human resource accounting (HRA) as the most promising method. But there is major problem with using human capital as the means to measure the economic value of organisational knowledge: the firm does not and cannot own human capital! (see Johnson, 2002). The problem is not so much that firms cannot own people, rather, researchers may have been looking at human capital the wrong way.

Human capital needs to be evaluated in terms of how it contributes to firm performance. This means that it has to be disaggregated into categories of other knowledge, knowledge that can be owned by the firm, and retained when employees leave. The disaggregation of knowledge into different types of capital has been used in previous research. This disaggregation is perhaps best viewed through the lens of the intellectual capital construct (see Stewart, 1998) because this is seen as knowledge owned by the firm rather than individuals. Researchers typically divide intellectual capital into four dimensions of capital: human capital, social capital, structural capital, and relation capital. Structural capital packages human capital in the form of codified (explicit) knowledge, e.g. databases and reports, which enable a firm to reuse it over and over. It therefore belongs to the firm, can be reproduced, shared and even sold (Stewart, 1998). Relational capital is knowledge gained through an organization's relationship with the people with whom it does business (Stewart, 1998). It is, therefore, the knowledge embedded in the relationships with customers and suppliers, but in a broader context includes stakeholders and strategic alliance partners as well (de Pablos, 2002). The outcome of the socialization of knowledge is often conceptualized as social capital. Social capital is characterized by being embedded in networks of mutual acquaintance, by making remote resources available through connections and contacts and by creating the ability to draw on social status and reputation once membership is established in certain networks (Nahapiet and Ghoshal 1998). It is seen as a public good (organizational resource) rather than a private good (individual resource) (Dess and Shaw, 2001).

KNOWLEDGE ABOUT KNOWLEDGE

In their survey of best practice knowledge management, Kluge, Stein, and Licht (2001) found that best practice companies do not try to store all their content in their information technology systems. Instead, they focus on saving knowledge about knowledge, as well as documenting basic knowledge that has long-term value and is fairly stable. More fluid and short-term knowledge need not be captured in IT systems; rather that should be managed through people (e.g. communities of practice). Kluge, Stein and Licht's (2001) argument is based on the notion that the fluidity of knowledge limits the need to codify and warehouse all knowledge. Some researchers argue that converting some types of highly tacit, experimental, and intuitive knowledge is counter-productive. According to Johnson (2002), the 'structuralising process' may institutionalise knowledge and develop core rigidities which constrain the value of tacit knowledge. This suggests that converting tacit knowledge to structural knowledge may actually decrease connectivity by denying people the opportunity to think, discuss, and develop ideas about a topic. These researchers argue that firms should abandon extant methods on knowledge value measurement and, instead, focus on what is really valuable for the firm. Johnson (2002) concludes that a strategy is needed to clarify what knowledge to structuralise (codify) and what knowledge to keep implicit (tacit). This approach will then help measure truly valuable knowledge resources.

A PRELIMINARY MODEL

This paper is an exercise in theory development which may then be tested by further empirical research. Our contribution is a taxonomy for identifying valuable human capital. Grounded in the intellectual capital literature, the taxonomy is based on tacit human capital, and three new constructs: tacit social capital (organizational memory), tacit structural capital (learning organization contribution), and tacit relational capital (knowledge tied to the individual rather than the position). The taxonomy combines a broad range of extant measurement constructs to develop a valuable human capital index. The most valuable knowledge is knowledge about knowledge. It is the most valuable tacit knowledge that is created as a result of the combination of human capital with the three other capital types. We now explain how this tacit knowledge creates value for the firm and then how to measure it. The assessments are validated by a 360 degree peer review, i.e. supervisors, peers, and staff are asked to rate one another using the framework below. The value measurement criteria are detailed in Table 2.

The value measurement of human capital

Valuable human capital results in increased organizational output (Osterman, 1987) and organizational productivity (Droege and Hoobler, 2003). Its value may be measured in terms of the activities it

enables employees to perform and the tacit knowledge resources available to the organization to create new knowledge, solve problems, or develop employee capability. In examining the contribution of human capital to firm performance, we adapt Barney's (2001) approach, where he conceptualizes resource value as 'those resources which can improve firm performance i.e. efficiency or effectiveness'. For knowledge management, this means efficient use of knowledge resources. Efficient usage may be interpreted as the time taken to search for necessary knowledge (see Liesch and Knight, 1999). This may then be linked to organizational performance in terms of cost reduction, speed of task completion and other outcome measures. Valuable human capital, therefore, may be measured in terms of a gap analysis: do employees have sufficient levels of knowledge to do their work? If not, organizational productivity is affected because people waste time learning or searching for knowledge.

For our purposes, we place the effectiveness measure in the context of the learning organization. The capability of the organization should be continually evolving and thus the way staff learn and solve problems contributes to organization-wide performance. Garvin (1993) defines a learning organisation as 'an organisation skilled at creating, acquiring, and transferring knowledge, and at modifying its behaviour to reflect new knowledge and insights'. Employees that contribute to learning organization capacity help others to understand the nature of problems and how to resolve them. Valuable human capital, therefore, may be measured in terms of a social network analysis: are employees willing and able to share their knowledge? If not, organizational output is affected due to a lack of synergy, i.e. the organization may produce less than the sum of its parts. The measure of human capital was grounded in two human capital constructs: knowledge levels (e.g. Tiwana, 2000), and knowledge facilitator levels (Martin and Salomon, 2003). Table 2 provides further details.

The knowledge levels are compared with the level required by the organisation to do each job (e.g. using the Hay method). There are three possible outcomes: the employee has more knowledge than is required (e.g. over-qualified); the employee has less knowledge than is required (e.g. incompetent); or the employee's knowledge matches what is required. The analysis is aggregated to determine the degree of fit between employees' knowledge and their work. If the firm's knowledge levels exceed requirements, then it is wasting resources. If the knowledge levels are below requirements, the firm lacks capability and might cause delays to task completion through staff training or other action. The resulting knowledge level score provides investors, management and others with an indication of how well the firm is using its human capital. The knowledge facilitator levels are compared with the

attributes of a learning organization. The resulting knowledge sharing score indicates whether the organization's capability is increasing.

The value measurement of social capital

Social capital creates value through relationships which provide the opportunity to create, share, and combine knowledge resources (Granovetter, 1992; Nahapiet and Ghoshal, 1998; Kogut and Zander, 1996). An important network element of social capital is organizational memory (Shah, 2000). This may be defined as the social network's accumulated experiences gained through learning by doing within the unique construct of the organization itself. The capacity to draw on accumulated knowledge of the past provides valuable insight for solving current problems. It may be considered a type of tacit social capital. Cascio (1993: 99) provides an example from a Fortune 100 company which had downsized where a bookkeeper earning $9 an hour was let go. Unfortunately, the company later discovered that it had lost valuable organizational memory because the bookkeeper knew questions to 'where's, why's, and how-to's' that no-one else apparently did. The company then hired the bookkeeper back as a consultant at $42 an hour! The most valuable social capital, therefore, may be measured in terms of organizational memory. The measure of social capital was grounded in four constructs: network ties, social relationships, social attitudes (Nahapiet and Ghoshal, 1998), and social dependence (Shah, 2000). Table 2 provides further details. The network tie and social relationship score provides investors, management and others with an indication of connectivity. The social attitude and dependence score indicates whether employees are motivated to share tacit knowledge.

The value measurement of structural capital

Learning organizations build capacity to learn and create knowledge in individuals and have the ability to distribute this knowledge though the organization (Thomas and Allen, 2006). Structural capital provides codified knowledge necessary to support the creativity and innovation underlying learning organization processes (Kanter, 1989). Employees turn to structural capital as a source of knowledge when they do not know what to do or want to learn something new. In this way, structural capital represents a basic building block of knowledge that may be used to increase the individual's and, ultimately, the organization's capability. The most valuable structural capital, therefore, may be measured in terms of contribution to learning organization capacity. The measure of structural capital was grounded in two constructs: codification attitude levels, and learning organisation attitude levels (Kluge, Stein, and Licht, 2001). Table 2 provides further details. The codification attitude score provides investors, management and others with an indication of the organisation's ownership of its

knowledge and, therefore, its sustainability. The learning organisation attitude score identifies the level of organizational commitment.

The value measurement of relational capital

The value of relational capital is that it provides feedback and shapes human capital by introducing suppliers, customers, contractors and partners' opinions to the employee's perspective. Previous research has identified that lost relational capital may disrupt or terminate the knowledge flow between the interacting organizations (de Pablos, 2002). At first glance, the exit of employees with relational capital should not have a significant impact because the participating organizations should be motivated to continue the relationship, e.g. to maintain revenues from a customer. The flow of inter-organizational knowledge is often important to both parties. The importance of the relationship means that both organizations need to manage it by establishing systems that will maintain it. However, there are relationships between organizations that extend beyond the formal requirement to interact. Some relationships between individuals involve an additional level of personal commitment that exceeds the formal requirements of their organizations to work together. This may create a tacit dimension to the inter-organizational relationship which cannot be simply transferred to a replacement employee. This tacit dimension of relational capital ties the knowledge flow to the individual rather than the position. The most valuable relational capital, therefore, may be measured in terms of the degree of personal relationship in inter-organizational knowledge flows. The measure of relational capital was grounded in two constructs: type of relationship levels (e.g. Maister *et al*, 2000), and type of knowledge flow levels (Schulz, 2001). Table 2 provides further details. The relational score provides investors, management and others with an indication of the vulnerability of the organisation's external relationships.

CONCLUSION

This paper aimed to develop a method for knowledge value measurement. Our literature review identified a lack of methods that measure value and also address the three main practitioner motivations: the need for improved internal management, improved external reporting, and regulatory reporting requirements. We argued that human resource accounting (HRA) was the best of the current methods because it measures human capital, which is a primary indicator of knowledge value. However, HRA methods are value assessments and lack the objectivity necessary for widespread managerial application. In addition, organisations cannot own people. This means their knowledge cannot be represented as an asset in any financial or non-financial report.

The paper's knowledge valuation method has two components. First, it develops a taxonomy of tacit knowledge which highlights the most valuable tacit knowledge in any organization (see table 2). We begin with human capital. We then introduce the constructs of tacit social capital (organizational memory), tacit structural capital (learning organization contribution), and tacit relational capital (knowledge tied to the individual rather than the position). Second, we develop an index for identifying the most valuable employees, based on a novel combination of extant measurement constructs, which represents a set of objective observable criteria, particularly when validated by 360 degree peer review. Our method is useful because it provides investors, managers, and others with a means to assess the 'health' of the organization in terms of its main value creating resource: tacit knowledge. We explain this statement by looking at each of the four tacit capitals identified by this paper from the perspective of investors and managers.

Human capital value measurements are indicators of productivity and output (e.g. profitability in financial terms). The knowledge level explains how well the firm is using its human capital. The knowledge facilitator levels identify whether the firm's capability is increasing. Unsatisfactory scores may suggest that employees are not competent to do their work and/or that there is a lack of knowledge sharing. These are red flag signals just like profitability indicators such as operating margin in financial statements. This will have a significant indirect impact on the three tacit capitals. Social capital value measurements are indicators of knowledge flow (e.g. cash flow in financial terms). The network tie and social relationship score explains the degree of connectivity. The social attitude and dependence score identifies whether employees are motivated to share tacit knowledge. Unsatisfactory scores may suggest that knowledge is being hoarded and/or that the organizational culture is unhealthy (e.g. does not support a learning organisation). This will result in a lack of organizational memory. Structural capital measurements are indicators of wealth (e.g. assets in financial terms). The codification attitude score identifies the organisation's degree of ownership of its knowledge. The learning organisation attitude score explains employees' level of organizational commitment. Unsatisfactory scores may suggest that there is high risk of valuable knowledge loss which threatens the organisation's future. This will result in lack of learning organization capability. Relational capital measures are indicators of market position (e.g. shareholders' equity in financial terms). The relational score identifies the vulnerability of the organisation's external relationships. Unsatisfactory scores may suggest that key inter-organisational relationships are fragile. This will result in relationships based on individuals rather than positions.

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Table 1: Classification of existing methods			
Method	Why Dimension	How Dimension	Description
Process methods			
Innovation capital	Improved external reporting	Financial valuation	Tangible end result of innovation such as commercial rights (Ordóñez de Pablos 2002),
Process capital		Value measurement	Value from intellectual capital is only created when raw materials are transformed into an end product through process and the benefit from this exceeds the cost (Robinson and Kleiner, 1996).
			The combined value of value-creating and non-value-creating processes (Ordóñez de Pablos, 2002).
Knowledge value added (KVA)			KVA analysis produces a return-on-knowledge (ROK) ratio to estimate the value added by given knowledge assets regardless of where they are located Housel and Bell (2001). In simple terms, KVA measures the revenue change that results from a process improvement against the cost of knowledge acquisition which enabled the improvement.
Financial methods			
Economic Value Added	Improved external reporting	Measurement	The objective of EVA is to calculate the net present value of an item, whether it yields more value than it consumes. It links capital budgeting, financial planning, goal setting, performance measurement, stakeholder communication, and incentive compensation.
Financial method of intangible assets measurement (FiMIAM)	Improved external reporting	Financial valuation	The FiMIAM provides a link between a firm's customer, process, and innovation capital and financial capital as well as show their interactions and interdependencies. It can assess the monetary value of the three intellectual capitals (human, structural, and customer) components and to add them to balanced-sheets. It has the ability to link intellectual capital value to market valuation, extending beyond book value (Rodov and Leliaert, 2002).

Human asset accounting systems			Human resources accounting (HRA) has evolved from earlier attempts to measure employees as assets. In a review of this literature, Roslender (2000) explain that the field began in the mid-1960s with Hermansson's finance-oriented human asset accounting This was followed in the late 1960s with Flamholtz who introduced the first management-oriented human resource accounting system. This was concerned with human resource cost and revenue information for the management processes of control, planning and decision. This was then followed by the sociology-oriented human worth accounting, which was based greatly on a range of subjective employee worth assessments, and on softer measurement metrics such as retention rates. Finally, this led to the current view which is referred to as human competence accounting.
Intellectual capital reports			
Intangible Asset Monitor (IAM)	Improving internal management	Measurement	The IAM measures stocks and flows of intangible assets. The three intangible assets that the IAM concentrates on are external structure assets, internal structure assets, and employee competence assets (Ordóñez de Pablos 2003).
The Balanced Scorecard		Value measurement	The Balanced Scorecard sets out to develop a central picture of measurement of management systems including financial elements as well as non-financial elements such as market, internal processes and learning that contribute to the performance of the organisation (Kaplan and Norton, 2001). It supplements traditional evaluating tools by providing addition views on building capacities and obtaining intangible assets required for future.
Skandia Value Scheme			Values components that result in intellectual capital (Ordóñez de Pablos 2003).
The Skandia Navigator			Provides a balanced view of both financial and intellectual capital (Ordóñez de Pablos 2003) with its advantage being labelled as "the balanced total picture it provides of the operations" (Ordóñez de Pablos, 2003, pp. 66). This means that a description of intellectual capital development is matched with financial results, capital, and monetary flows, and level and change indictors of both terms of capital are emphasised (Ordóñez de Pablos 2003).
Tango			The Tango method studies intangible assets in comparison to financial assets (Ordóñez de Pablos 2003). It identifies, measures, and manages intangible assets on three bases including growth and renewal, efficiency, and stability of the firm's parameter (Ordóñez de Pablos 2003).
Intellectual Capital Accounts (ICAP)	Improving internal management	Value assessment	The ICAP methodology emphases the strong link between intellectual capital and business performance by focusing on the value chain (Engström, et. al. 2003)

Action Research		Measurement	This approach suggests the process of measuring intellectual capital is beneficial because it actually creates new knowledge and, therefore, makes an important contribution itself (Mouritsen, 2004).
Tobin's Q	Improved external reporting	Financial valuation	Developed by the Nobel Prize Winner James Tobin, "measures the ratio between market value and reposition value of organizational physical assets (Ordóñez de Pablos 2003). This is in tune with the claim that market value is an ideal measure of intellectual capital (Robinson and Kleiner, 1996).
People methods			
Human Resource Accounting (HRA)	Improving internal management	Value assessment	HRA's main aim is to "quantify the economic value of people to the organisation in order to provide input for managerial and financial decisions" (Bontis, et. al. 1999, pp.393). There are three types of HRA measuring models, which are: 1. cost models which consider the historical, acquisition, replacement or opportunity cost of human assets; 2. HR value models which combine non-monetary behavioural with monetary economic value models; and 3. monetary emphasis models which calculate discounted estimates of future earnings or wages. (Bontis, et. al. 1999).
Value Added Intellectual Capital (VAIC) Indicator		Measurement	This measures the level of efficiency in terms of human capital and structural capital and ranks organisations accordingly (Goh 2005).
Hay Skills Audit		Value assessment	This measures human capital based on using an "indicator" of the human skills used to create value. For example, evaluating personnel through Hay methodology is a common way to measure the amount of know-how in a firm. The rationale behind this is to retain the human capital that yields competitive advantage within the organisation (Robinson and Kleiner, 1996), thus, retaining the intellectual capital that produces value. It measures the potential capability and actual impact of employees through evaluating job categories using the three "Hay factors" that include know-how, problem solving, and accountability (Robinson and Kleiner, 1996). This measures the intellectual capital brought by each employee to the organisation and allows the level of skills of individual employees to be tracked determining where skills are needed for new positions and human resources development (Robinson and Kleiner, 1996).

Learning organisation capability		Measurement	Learning in organisations is based on the mental models of decision makers that aid routine decision making and also make new learning possible (Robinson and Kleiner, 1996). By identifying the organisation's learning ability through evaluating these mental models, intellectual capital can be measured as the ability to respond to the need for change and learn from experience (Robinson and Kleiner, 1996).
Learning efficiencies		Measurement	Turner and Jackson-Cox (2002) argue that knowledge can be valued in quantified terms. Their model quantifies the value of knowledge derived from cost, investment return, and the knowledge obtaining duration. It is similar to the KVA method except this approach focuses on the time taken to acquire or learn the necessary knowledge and, therefore includes the trade-off or opportunity cost involved in learning.

Table 2: Knowledge Measurement Criteria
Human capital
Knowledge levels evaluate the employee's level of knowledge in each activity where they feel they have some knowledge. Based on a series of questions about their knowledge, we allocate a knowledge level score based on the following scales: 1 is *ignorance* (do not demonstrate any understanding of the activity), 2 is *have seen others doing it* (can provide a basic description of the activity), 3 is *know basics of what to do* (can explain how to do the activity in very basic terms), 4 is *know what to do* (good understanding of procedures and can show somebody how to do the activity), 5 is *know-why* (understands the activity within a bigger context of cause and effect, and understands the impact of their work), 6 is *know how to do it well* (i.e. identify measures of performance, demonstrates very good procedural knowledge, and can also discuss performance measures), 7 is *can control performance* (i.e. do it consistently well and shows good awareness of impact of having done a good job), 8 is *best practice* (can identify key processes leading to consistent best practice), and 9 is *can demonstrate/teach key processes* (is nominated as a best person people turn to for help in this activity). *Knowledge facilitator* levels evaluate an employee's willingness and ability to share their knowledge. Based on a series of questions about their attitude to sharing knowledge, we allocate a knowledge facilitator score based on the following scales: 1 is *ability to use structural capital* (uses policy information to perform task), 2 is *ability to use contacts* (uses contact information to perform task), 3 is *work on problem solving groups* (demonstrated involvement in value adding teams), 4 is *can create or innovate to solve problems* (demonstrated useful ideas), 5 is *can explain how to solve problems* (nominated by others as someone who helps them solve problems), and 6 is *can document problem solving creativity* (nominated by others as someone who helps them document creativity).
Social capital
Network ties is a structural dimension of social capital. We allocate a network tie 'score' to individuals based on their number of contacts, the importance of these contacts, and the frequency of contact. The score is based on the following levels: 1 indicates *isolated* (one or no contacts); 2 is *local work area* (between two and four internal contacts), 3 is *extensive internal contacts* (five or more internal contacts), 4 is *boundary spanner* (two or more external contacts), and 5 is *networker* (eight or more contacts (internal and external). *Social relationships* involves structural (organisational), relational (individual), and cognitive (group) dimensions of social capital. It is defined as respondents' level of interaction with internal and external contacts (Nahapiet and Ghoshal, 1998). In this way we may allocate a social relationships 'score' to individuals based on the depth and breadth of the relationship. The score is based on the following levels: 1 is *information supply* (nominated by others as providing information), 2 is *command and obey* (nominated by others as giving work or reviewing work), 3 is *customer* (nominated by others as being an internal customer). These are organizational level relationships. Next, 4 is *purely professional relationship* (nominated by others as helping solve problems but no real social links), 5 is *exchange favors* (nominated by others as helping solve problems and a cooperative relationship), 6 is *friendship* (nominated by others as helping solve problems and a good friendship). These are individual level relationships. Finally, 7 is *professional group membership* (nominated by others as someone they work with as part of a problem solving team), 8 is *informal knowledge creation* (nominated by others as someone who voluntarily helps them solve problems by working together), and 9 is *innovator* (nominated by others as an innovative problem solver in working with others). *Social attitudes* is a cognitive dimension of social capital. It is defined as respondents' obligation or expectation of relationships with others, which creates motivation to engage in social interaction in order to fulfil the duty (Nahapiet and Ghoshal, 1998). In this way we allocate a social attitude 'score' to individuals based on the willingness to develop relationships with others at work. The score is based on the following levels: 1 is *introverted* (anti-social attitudes), 2 is *friends at work* (social behaviour), 3 is *tribal* (close group affiliation), 4 is *uninhibited* (unrestrained communication), and 5 is *learning* (learn from colleagues). *Social dependence* is a relational dimension of social capital. It is defined as the degree of influence of the individual's direct ties or social relationships (Shah, 2000). In this way we allocate a social dependence 'score' to individuals based on evidence of important social networks. The score is based on the following levels: 1 is *isolation* (no-one nominated as having had an

influence on career or having an impact when left), 2 is *been influenced by others*, (some-one nominated as having had an influence on career but no-one nominated as having had an impact when left), 3 is *been affected by staff exit* (no-one nominated as having had an influence on career but some-one nominated as having had an impact when left), 4 is *been influenced by others and affected by staff exit* (some-one nominated as having had an influence on career and some-one nominated as having had an impact when left), and 5 is *significantly dependant* (indicated that some-one has had an important positive influence on their career or some-one's exist has had a significant negative impact).
Structural capital
Codification attitude levels evaluate the respondent's willingness to codify their tacit knowledge. In this way we may determine respondents' contribution to the stock of knowledge owned by the organisation. Based on a series of questions about what they do with new knowledge or when they learn something new, we allocate an attitude level score based on the following scales: 1 is *retain knowledge* (do nothing with the knowledge), 2 is *apply knowledge* (just use knowledge to do the job), 3 is *share knowledge with close contacts only* (tell boss and colleagues), 4 is *share knowledge with everyone* (tell customers, suppliers), 5 is *codify outputs* (document knowledge or place on an Intranet), and 6 is *train others* (conduct a training course). *Learning organisation attitude* levels evaluate the respondent's view of the organisation. In this way we may gain further insight into the respondent's likelihood to contribute to the stock of knowledge owned by the organisation. Based on a series of questions about their perception of their workplace as a learning organization, we allocate an attitude level score based on the following scales: 1 is *unlearning organization* (no evidence of organizational-level learning), 2 is *investment in human capital* (leaders invest in ideas and people), 3 is *performance management* (outcomes are measured, captured and reported), 4 is *tacit knowledge is codified* (valuable knowledge is captured and codified), 5 is *knowledge community* (processes that encourage knowledge creation and transfer), and 6 is *knowledge creation* (processes that indicate a truly learning organization benchmarked against industry best practice).
Relational capital
Based on a series of questions about their relationship with external stakeholders, we can allocate a *type of relationship level score* based on the following scales: 1 is *short term professional* (the relationship is limited to the business transaction), 2 is *long term professional* (the relationship is limited to contract management, e.g. Standing Offer etc), 3 is *restricted information flow* (the relationship allows some information exchange), 4 is *access to relevant information* (the relationship allows deep information exchange), 5 is *partly integrated into business processes* (the relationship shows signs of being a true partnership), and 6 is *fully integrated into business processes* (the relationship is a true partnership). *Type of knowledge flow levels* evaluate the degree of knowledge creation between the respondent and the external stakeholder. Based on a series of questions about the type of knowledge exchange with external stakeholders, we allocate a type of knowledge flow level score based on the following scales: 1 is *feedback* (customer or supplier reviews performance), 2 is *information source* (customer or supplier is an important source of knowledge for activities), and 3 is *knowledge creation* (customer or supplier helps solve problems or create new knowledge).