Intellectual capital
Measurement effectiveness

Gopika Kannan
DaimlerChrysler Research and Technology India, Bangalore, Karnataka, India
Wilfried G. Aulbur
DaimlerChrysler AG, Stuttgart, Germany

Keywords *Intellectual capital, Measurement, Knowledge management*

Abstract *Intellectual capital (IC), knowledge management and intangible assets are important factors in determining the value of an organization, as reflected in the growth of the knowledge management industry. There is however, a lack of effective measurement techniques to specify and optimize the value of IC. This paper presents a detailed review of existing techniques and establish the need for a more comprehensive approach. The proposed framework addresses IC valuation issues across the IC cycle. People, process, and technology are measured and correlated in the final step with social and financial measures, thus providing a new framework.*

1. Introduction

Over the last decade, businesses have recognized the importance of managing their intangible assets. The development of brands, stakeholder relationships, reputation and the culture of organizations are viewed as providing sustainable sources of business advantage. The ability to build and leverage the value of these intangible assets constitutes a core competency for organizations.

However, recent studies (McGrath, 1996) claim that empirical evidence and work, supporting theory is lacking. Clearly, empirical work must be based on adequate measurement frameworks that capture the organizational, process and financial impacts of knowledge intensive business strategies[1].

Early measurements of intellectual capital (IC) focus on the accounting and financial perspective. Most of the research centers primarily around three questions: What causes the discrepancy between a firm's book value and the value of its physical assets? What are their intangible assets? And what characterizes their value? We need to define what constitutes intellectual capital, to answer these questions.

1.1 Defining IC

Intellectual capital can be defined as intellectual resources that have been "formalized, captured and leveraged" to create assets of higher value (Prusak, 1998). IC refers to intellectual material such as knowledge, information, intellectual property and experience that can be used to create wealth. Intangible assets are innately difficult to measure and include a large number of organizational and individual variables. Simple financial measures fail to take cognizance of the complex nature of these assets.

IC can be classified as human capital, organizational capital and customer capital (Bontis, 1996; Edvinsson and Sullivan, 1996; Roos and Roos, 1997; Stewart, 1995).

Human Capital refers to the accumulated value of investments in employee training, competence, and future. The term focuses on the value of what the individual can produce; human capital thus encompasses individual value in an economic sense

Journal of Intellectual Capital
Vol. 5 No. 3, 2004
pp. 389-413

1469-1930
DOI 10.1108/14691930410550363

(Becker, 1992). Human Capital can be further sub-classified as, the employees' competence, relationship ability and values. A simple example provided by Kindred Pederson of Southern California Edison indicates that if a software package sells for $1 million before employee modifications and $3 million after employee modifications, then the human capital used to modify the software is $2 million.

Organizational capital is the supportive infrastructure that enables human capital to function. Edvinsson and Malone (1997) further classify structural capital into organizational, process and innovation capital. Organizational capital includes the organization philosophy and systems for leveraging the organization's capability. Process capital includes the techniques, procedures, and programs that implement and enhance the delivery of goods and services. Innovation capital includes intellectual properties and intangible assets. An organization's policy and procedures, customized software applications, research and development programmes, training courses and patents are examples of organizational capital.

Customer capital is defined as the combined value of the relationships with customers, suppliers, industry associations and markets. Customer capital refers to issues like trust and understanding and the strength and loyalty of customer relations. Customer satisfaction, repeat business, financial well-being, and price sensitivity may be used as indicators of customer capital.

1.2 Benefits of measurement of IC

Our goal is to measure the value of organizations knowledge assets, both organizational and human capital, in order to justify investments in intellectual capital. A key reason for measuring intellectual capital is to recognize hidden assets and strategically develop them to achieve organizational goals.

The benefits of IC measurement include the following.

- Identification and mapping of intangible assets.
- Recognition of knowledge flow patterns within the organization.
- Prioritization of critical knowledge issues.
- Acceleration of learning patterns within the organization.
- Best practice identification and diffusion across the firm, by presenting a strong business case for the best practice.
- Constant monitoring of asset value and finding ways of increasing value.
- Increased understanding of how knowledge creates interrelationships.
- Understanding organizational social networks and identifying change agents.
- Increase in innovation.
- Increase collaborative activities and a knowledge sharing culture as a result of increased awareness of the benefits of knowledge management.
- Increased employee self-perception of the organization and increased motivation.
- Creates a performance-oriented culture.

Measurement of IC and knowledge management practices will result in significant benefits to the organization that will help determine business strategy, process design as well providing competitive advantage. While discussing all points mentioned above

in detail is beyond the scope of this paper, a few case studies based on our personal experience are in order.

1.3 Limitations of current measurement systems

A detailed literature study (Bontis, 2001) identified several limitations in the existing measurement systems, which are as follows

- The existing approaches relate to the organization as a whole and do not account for individual departments or knowledge workers.
- They do not balance past-orientation with future predictions, or quantitative financial measures with qualitative perceptual and process measures.
- Behavioral dynamics and its impact on organizational economics are not measured.
- There is no system for measuring process effectiveness in capturing tacit knowledge transfer.

The above limitations can be overcome by integrating financial measures, with perceptual, process and systems measures. Such an approach will account for every individual department in the value chain and will also help to identify key factors, which influence IC effectiveness or retard its growth. The existing measurement systems are discussed below.

The existing measurement systems can be broadly classified as belonging to the financial or accounting framework or the perceptual school of thought. We further classify the non-financial and non-perceptual measurement systems as "other measurement techniques". We discuss the different measurement frameworks and their limitations below. Table I summarizes this discussion and provides an overview of the different measurement frameworks.

1.3.1 Financial measurement system. Financial measurement systems are a classification system for all IC measurement techniques that address financial contributions made through IC assets Conventional cost accounting shows the costs of individual production operations without connection to other activities, e.g. marketing, service, etc. As production was the dominant activity, the results of all other activities in a company were not registered separately, rather they were considered general (indirect) costs. A small shift was made when activity-based costs (ABC) were introduced. This represented certain advancement, as costs per individual activity could be controlled in a better way and provided some sort of connection with the whole. Regardless of this, the measuring system based on cost accounting has proved totally inadequate for contemporary circumstances.

Financial statements fail to measure and show the "most significant building blocks of business", which is the human capital, organizational capital, and customer capital. As a result, these financial statements fail to communicate about the state of the business in terms of IC development to the management and investors. The current accounting framework, which is transactional and realization based, only recognizes the existence of an item when transactions with third parties take place (Brennan, 1999). This does not hold good for IC measurement.

Intangibles such as staff competencies, customer relationships, business models, and computer and administrative systems receive no recognition in the traditional financial and reporting model. Interestingly, even traditional intangibles like brand

Advantages	Disadvantages
Perceptual measures	
Perceptions affect attitudes and behaviors	Difficult to establish causal relations, hence cannot be generalized
Culture is a measure of normative behaviors	Subjective in nature and hence lead to bias
Knowledge of employee perceptions can help the organization design more acceptable processes and bring about behavioral change	Not correlated with performance and profits
When used to measure perceptions of process effectiveness, they can lead to continuous process improvements	
Process measures	
Mapping and establishment of current processes	Too much formalism
Determination of process/system usefulness and effectiveness (usability statistics)	Can be confusing when dealing with too many knowledge domains
Predict future performance/infrastructure requirements	Can be effective only when knowledge flows are enabled across domains
Lead to tangible benefits in terms of learning time and cycle time reduction	Not linked to profits or tangible improvements
Financial measures	
Provides the shareholders with a financial value of the organizations intangible assets	Too complex incorporates several variables and cannot be standardized
Clearly links spending on intangibles with profits	May not be always possible to account for earnings from intangible assets
Measures like ROA and ROI, as well as KCV provide for intangibles in the accounting framework and justify spending on intangible resources	Dependent on external factors such as market exuberance
By linking process and financial the organization can measure and improve its IC effectiveness	Does not take into consideration process and people factors and cannot be used to identify problem areas and design improvements
Other measures	
Social network measures determine the optimum intangible resource allocation and utilization required for increasing the rate of innovation	These measures do not consider individual perceptions and hence may not result in the requisite behavioral change
Human capital value addition measures determine the organizational processes that can be improved to sustain and increase the human capital value addition	
Econometrics measures reveal tangible benefits and value of intangible assets and resources	

Table I.
The four schools of IC measurement and analysis of their advantages and disadvantages. Our integrated framework is based on these four schools and results in an effective IC measurement system

equity, patents, and goodwill are reported in the financial statements only when they meet stringent recognition criteria, otherwise they have, until recently been omitted from the financial statements (IFAC, 1998; IASC, 1998).

The limitations of the existing financial reporting system for capital markets and other stakeholders have motivated an evolving dialogue on finding new ways to measure and report on a company's IC. The product of this dialogue is a plethora of new measurement approaches that all have the aim, to a greater or lesser extent, of

synthesizing the financial and non-financial value-generating aspects of the company into one external report. Principal among the new reporting models are the knowledge production function (Machlup, 1962); the intangible asset monitor (Sveiby, 1997, 1998; Celemi, 1999); the balanced scorecard (Kaplan and Norton, 1992, 1996); the skandia value scheme (Edvinsson and Malone, 1997); the IC accounts (DATI, 1998); and the knowledge capital scorecard (Lev, 2000). Each of these seminal works defines a particular class of financial reporting model. Table II provides a useful framework for comparing several of the main financial measurement approaches.

The "new" measurement frameworks have certain limitations. They do not factor in the effect of human behavior and attitudes, social networks or the importance of tacit knowledge transfer. The limitations of the current measurement systems will be discussed in detail in the literature review section.

1.3.2 Perceptual Measurement Techniques. The perceptual school of thought concentrates on employees' perceptions and their need for an effective knowledge management system Perceptual measures include employee perceptions of top management commitment, need for knowledge sharing and knowledge management, perceptions of the value addition and of equitable reward structures. The perceptual school of thought also emphasizes the role of organizational culture in influencing IC value adding behaviors.

Analysis of organizational culture is essential for understanding knowledge flow in an organization. We define culture as the shared values, beliefs, and practices of the people in the organization. Culture is reflected in the visible aspects of the organization, such as its mission. It is embedded in the way people act, what they expect of each other, and perceptions of other's actions (Schein, 1996).

Clearly, behaviors determine that the organizations culture and employee attitudes are important determinants of knowledge sharing behavior. For example, individuals hold certain beliefs and in the process of socialization they share their beliefs and this becomes tacit knowledge. When an individual externalizes those beliefs, tacit knowledge becomes explicit team knowledge (Nonaka and Konno, 1998). This indicates the importance of individual knowledge worker perceptions and beliefs and their importance with relation to value creation and value addition.

Developed by	Framework	Classification model
Machlup (1962)	Knowledge production function	Investments in knowledge capital Production costs Economic growth
Sveiby (1988, 1997)	The intangible asset monitor	Internal structure External structure Competence
Kaplan and Norton (1992)	The balanced scorecard	Internal processes perspective Customer perspective Learning and growth perspective Financial perspective
Edvinsson and Malone (1997)	Skandia value scheme	Human capital Structural capital
Lev (2000)	Knowledge capital scorecard	Total earnings Earnings from tangible assets Knowledge capital earnings

Table II.
Frameworks for classifying intellectual capital reporting models

There is no standardized procedure to evaluate or determine how an organization's culture supports the IC development. Managers need a conceptual framework of the links between culture and knowledge to design the interventions needed to create behaviors that will support their knowledge management objectives (DeLong, 1997). Current methodologies for culture assessments are correlational in nature, do not provide causal relationships and therefore cannot be generalized.

The perceptual approach is inadequate as it focuses on individual levels of analysis and it is uncorrelated with performance and profit. It is a self-concept based approach and could lead to subjective bias in the measurement of IC.

1.3.3 Other measurement techniques. Measurement techniques that cannot be classified as purely financial or perceptual fall under this category. They include measures of social networks, process measures and systems measures. Several measurement techniques are discussed in detail in the literature review section. A combination of financial, perceptual and "other" measures will result in value adding behaviors and resultant organizational effectiveness.

1.3.4 Motivation for the study and research objectives. Based on our analysis of literature we are convinced that there is a need for a more holistic and integrated approach to IC measurement that will result in measurement of systems, processes and people issues and their impact on the organizations' profits Table III shows a brief review of literature, research gaps found and the need for further research. Specific measurement techniques will be discussed in detail in the literature review section.

The measurement gap analysis detailed above and our extensive literature survey shows that there is a need for a more integrated and holistic approach to IC measurement. The new approach must result in measurement of systems processes and people issues and their impact on the organizations' profits. We believe that the measures and tools developed in this paper will enable managers to harness and develop an organization's IC in a more accurate and proactive way than currently possible.

This paper attempts to achieve the following objectives.

- To identify how IC is measured and reported.
- To assess the current measurement techniques against the needs of knowledge intensive organizations.
- To propose an integrated and holistic methodology towards IC measurement, which can be used as a diagnostic and also as a tool for financial decisions.

2. Methodology framework

Over 100 papers on measurement techniques and theories on intellectual capital were reviewed and analyzed. Figure 1 presents the methodology flow chart.

We studied over 100 papers on IC management, which modeled IC effectiveness and also presented financial, perceptual, process and other techniques for IC measurement. We then short listed methodologies that were of interest to us in our organization, using the following criteria: practicability, theoretical validation and measurement effectiveness regarding its impact on bottom line results. Specific financial, perceptual, and process and other measures were then identified and selected to provide an integrated IC measurement framework. The next phase involved design of specific stage wise techniques for IC management and measurement. The stages include needs

Author	Year	Findings	Further research
Penrose	1959	Organization as a knowledge repository	Need for studying organizations knowledge
Machlup	1962	Knowledge production and distribution in American Society and the importance of knowledge work and the knowledge worker	Empirical impetus to knowledge production
Bass	1969	Bass diffusion model describes the empirical adoption curve	To fit the Bass curve as a process, outcome measure of adaptability
Hinings *et al.*	1974	Work-based learning is a key practice in transforming organizational practice – power resources are traded away	What does it entail? And how should it be brought about?
Basili	1984	Basili put forward the Goal Question Metrics Paradigm for continuous process improvements	The paradigm is perceptual process in nature and there is need for further work in terms of tangible measures for process improvements and linking them to financial benefits
Karl Sveiby	1986	Need for behavioral perspective as an addition to intangible assets monitor	Good tool for financial appraisal of intangibles, but does not help in understanding employee perception of value addition and increasing it
Prahalad and Hamel	1990	Core competency theory- path breaking	Specialist knowledge alone, does not consider organizational capital and tacit generalist knowledge
McAteer	1991	Four characteristics of high value adding perceptions: accelerate learning, framework for testing innovation, reduce risk, link between process and results, reduce costs	Importance of the possible relations between process effectiveness measures and perceptual measures leading to more effective IC management
Nelson and Winter	1992	Knowledge stored as predictable behavioral patterns	Impetus for exploring human capital value addition
Hall	1992	Resource based view of the firm	Does not take people into consideration
Foucault	1992	Communication processes and capacity building measures help manage intellectual capital	Clearer understanding of communication processes and their importance
Davenport	1994	Managing knowledge is not just an issue of technology but managing social relations also	Evidence related to importance of people, yet no specific measures of value addition
Nonaka and Takeuchi	1995	Knowledge – ideas, skills and expertise can be captured and shared	What is the most effective way of doing that? How does it contribute to value addition?

(*continued*)

Table III.
Representing the literature surveyed, important findings and research gaps

Author	Year	Findings	Further research
McGrath	1996	KM for strategy and innovation – important, but inadequate studies	No theories for organizational knowledge management
Senn	1996	Top performing information technology (IT) professionals with needed specialized skills are in short supply	Important for IT management to understand the characteristics and behaviors of high performing IT personnel
APQC	1997	Lasting organizational change is dependent on cultural change; and requires formal education and training, communication, infrastructure and financial incentives	Need for a holistic model that incorporates financial, perceptual, process and social measures
DiMattia and Oder	1997	Findings show that organizations have lost a lot of information and expertise through loss of people	Need for knowledge capture and leverage through effective human capital management
Philips	1997	Return on investment on knowledge assets	
Ginchereau	1997	Usability statistics for knowledge management IT solutions. Ginchereau.B devised performance measures for Knowledge Management systems and used them to compare different Knowledge Management technologies	Need to integrate it and technology performance with processes, people factors and financial returns
Edvinsson and Mallone	1998	Intellectual capital theory and first organizational application	Financial rather than a behavioral parameter. Difficult to improve performance and design diagnostics
Sieloff and Shih	1998	HP culture selects and rewards loyal employees (those who share and contribute). Has had a steady growth rate of 20 percent, while start up have higher turn over. Training is important to build knowledge capital	Does not explore the direct relationships between rewards innovation and performance. Need for a holistic optimal model for value addition
Tobin	1998	The knowledge enabled organization uses the knowledge and skills of all employees, regardless of level or function. It provides tools and opportunities to share knowledge. Employee perception of the same may be a determinant of contribution. Organizations use only 10 percent of employee knowledge – need for efficient systems	Need for incorporating perceptual and systems measures in IC valuation

Table III.

(*continued*)

Author	Year	Findings	Further research
Warren	1999	APQC study stating that though technology may be necessary for KM, it is not sufficient. People value addition is important	Does not indicate factors involved in people value addition
Warren	1999	Biggest barrier to knowledge sharing are cultural factors that holding information is more valuable than sharing it	Need to explore knowledge worker perceptions and design programs and systems to overcome these barriers
Meyer	1999	Unsupportive cultures, where knowledge sharing is not considered a value added activity, leads to low knowledge sharing behaviors	Need for a more detailed study of perceptions and behaviors of organizational factors leading to value addition
McAdam and McCreedy	1999	Rated knowledge transfer, learning, core-competencies, knowledge capture and dissemination, education, experience, and culture as issues related to knowledge intensive organization. Tacit knowledge is perceived by 81 percent of the sample as being captured by informal discussions	Need to understand the exact relationships, organizational dynamics and social networks
Chug	1999	Have an effective KM support system which is seen to facilitate value addition	Explore the relations between knowledge management systems and IC Value
Harvey and Lusch	1999	Attempt to evaluate the liability side of intangible assets but did not touch the people element. The "great divide" is around the question: "is this activity/person contributing positively to future value creation or not?"	Diagnostic tool for measurement of human capital
Dell and Mcdormott	2000	Companies successful in promoting knowledge sharing culture, adapt their KM approach to fit their culture. Visible link between knowledge sharing and problem-solving. Knowledge sharing is built around networks people use in daily work	Need to evaluate perceptions of culture and its relation to value addition to the organization
Mayo	2000	The need to create a value adding chain, and to see where the individual fits into it	Need to create a theoretical model to understand value addition

(*continued*)

Table III.

Author	Year	Findings	Further research
Goshal *et al.*	2000	3M-innovation and NPD, Enron creates value through culture change. Case studies of value creating organizations	Need to look at process variables that go towards creating IC Value
Chong *et al.*	2000	A key element in value addition is knowledge codification and sharing. It benefits the organization better decision-making, more efficient staff. Knowledge investments are not adding value because of the low organizational environments disabling competency sharing. Formal frameworks would be beneficial to link between internal resources and company performance; to close the gap between the level of expectations of senior managers and the level of delivery of projects	Employee perceptions of these factors need to be understood and integrated into a holistic theory for value addition
Garrick and Clegg	2000	Degree of learning are now deployed by organizations as components of reward systems-effect efficiencies in individual and organizational performance	Importance of learning and reward delineated, and to be integrated in a model for increasing value addition
Campbell	2000	Management initiatives could be used to increase firm functioning and productivity, through increased employee value-add. Many elements of employee value addition- network, perceptions, behavioral competencies and attitudes are not included in competency frameworks	Perceived and expressed need for a behavioral model and tool to understand and assess these competencies
Carley	2000	Measures for organizational architecture and performance based on social network analysis	Possible correlations with processes and outcomes
Nickols	2000	Design or redesign of business processes should factor in an understanding of where and how knowledge plays a role in the performance of the process	Understand processes that facilitate knowledge sharing and creation as well as value addition

Table III. (*continued*)

Author	Year	Findings	Further research
Iske	2001	The value potential of knowledge and the importance of context, ease of transfer and usage	Knowledge value potential coupled with ROI and process and systems measures can give an accurate estimate of IC development
Kannan and Akhilesh	2001	Human capital knowledge value addition, a perceptual process diagnostic of knowledge value addition	Possibility of linking value addition diagnostics to financial outcomes and process measures

Table III.

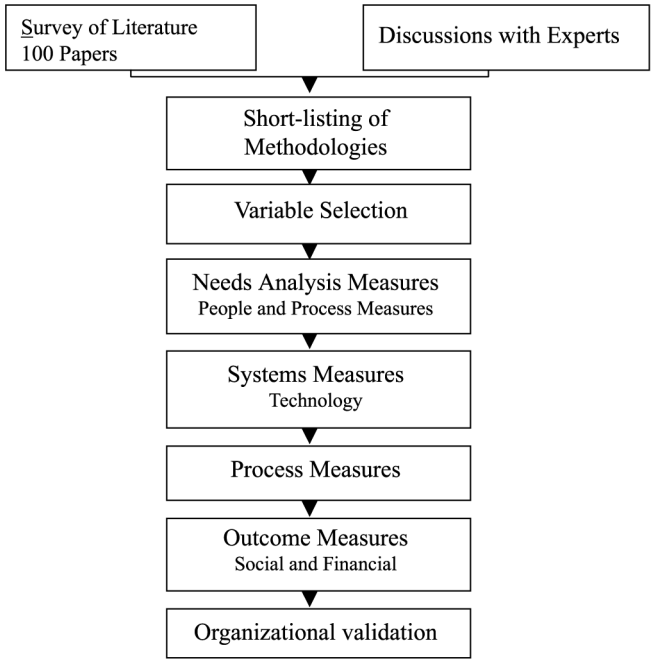

Figure 1.
Methodology flow chart

analysis measures, systems measures, process measures and outcome measures. Needs analysis refer to the measurement of organizational readiness for knowledge management and IC development and the employees perceived needs towards IC practice. The measures are perceptual in nature and involve people and their perceptions of organizational processes. Systems measures refer to performance of technology for knowledge management. Process measures involve the measurement of process effectiveness and outcome measures refer to the tangible and intangible outcomes resulting from IC. Outcome measures include financial measures and social measures. Existing measurement techniques are incorporated into the above framework. Figure 2 shows a graphical representation of IC measurement frameworks as presented in this paper.

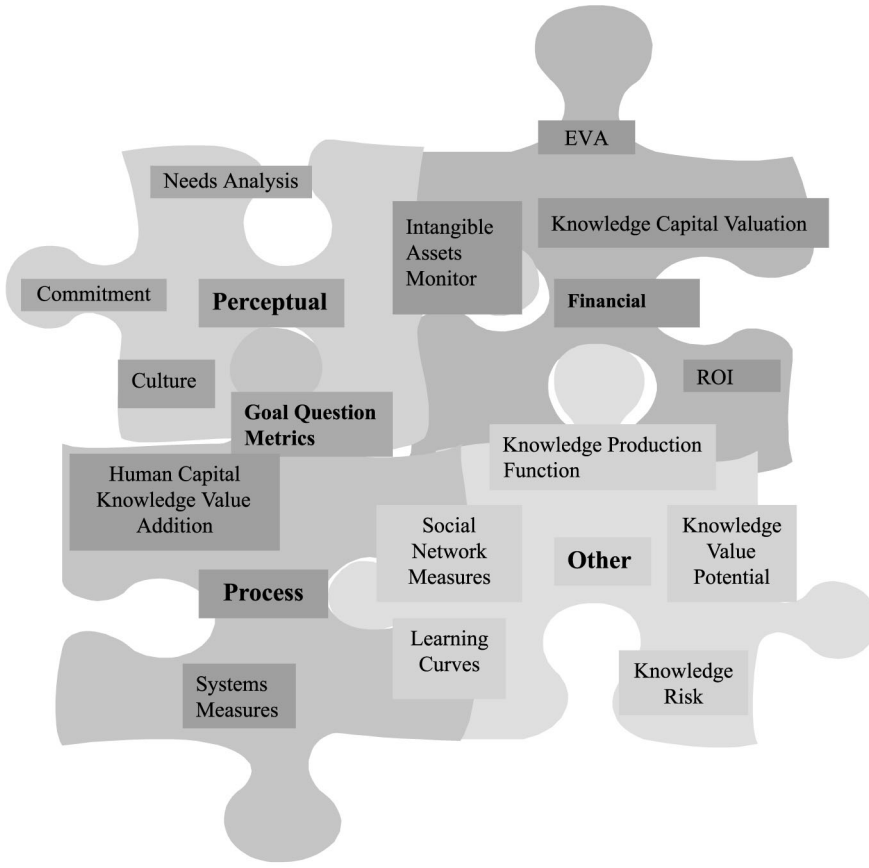

Figure 2.
Graphical representation of IC measurement frameworks that can be classified as perceptual, financial, process and other

Note: For a definition of the measurement categories see section 2.3 or table 1. All measurement techniques shown here are used in our integrated IC measurement approach and described in detail in the literature review chapter

3. Survey of literature

Over 100 papers on intellectual capital research and practice were analyzed. The literature surveyed included financial and accounting measurement techniques, perceptual measures, process and systems measures, social networks analysis techniques, and econometric techniques for intangibles measurement. The measurement framework is described in Figure 3 and the advantages and limitations of each measurement "type" are presented in Table III.

We discuss in detail about the seminal studies and popular frameworks for IC measurement, their drawback in general and the need for an integrated framework has been presented in Section 2. Hence we focus on drawbacks of specific measurement techniques in this section. We will present a detailed analysis of goal-question-metrics paradigm (GQM) (Basili and Perricone, 1984, Basili and Musa, 1991, Basili *et al.* 1994; Bhatt, 2000), the intangibles assets monitor (Sveiby, 1996, 1998; Bontis, 2001),

Skandia framework (Edvinsson and Malone, 1997; Sveiby, 1998; Bontis, 2001), Bagelleri's R&D measures, (Bagelieri, 1997, 2000), knowledge capital value (Lev, 2000; Stewart, 2001), human capital value added (Kannan and Akhilesh, 2002), carnegie measures of knowledge architecture and performance (Carley *et al.*, 2000), economic value added (Bontis, 1999; Starssman, 1999; Sveiby, 2001,West, 1999), organizational culture (Argyris, 1982; DeLong, 1997; Denison, 1982, Schein, 1996), return on investment, (Phillips, 1997), knowledge value potential (Iske and Boekhoff, 2001), knowledge production function (Machlup, 1962; Swanstrom, 2001), and learning and diffusion curves (Lam, 2000; Roth, 1995; Swanstrom, 2001; Watkins, 2001).

The literature reviewed is classified as financial, perceptual, perceptual process and other measures as shown in Figure 3.

3.1 Perceptual measures

Perceptual measures, as discussed in Section 1.3.2, focus on employee perceptions of the current practices and the benefits garnered through them. Perceptual measures have several limitations, as discussed in Section 1.3.2, but are still important as they can help to clarify possible barriers to IC effectiveness. Needs analysis, cultural analysis and commitment measures are perceptual measures, which are essential for understanding the organization's readiness for knowledge management activities and commitment to IC development and leverage.

3.1.1 Needs analysis. The success of a KM implementation program depends upon the organizations readiness and acceptance of the program. Any change can be brought about only through the organizations awareness of the need for change, acceptance of it and cooperation and commitment to it. This is possible only when the change agent has a clear understanding of the members' needs. Thus, the first step in the process would be to carry out a needs analysis (APQC, 2001; Hylton, 2002).

Needs analysis is the measurement process which reviews and maps organizational information need, creation, use, flow, and storage; identifies gaps, duplication, costs; and value; and uncovers the barriers to effective knowledge flow. The analysis is used to investigate the company's knowledge environment, ecology, knowledge use and sharing and most importantly the employees' perceptions of knowledge management effectiveness (Hylton, 2002).

Needs analysis involves questionnaire-based studies of employee perceptions of knowledge management initiatives, knowledge sharing within the organization, knowledge criticality and prioritization. Mind mapping tools are used for knowledge management needs analysis (Sprotte, 2000).

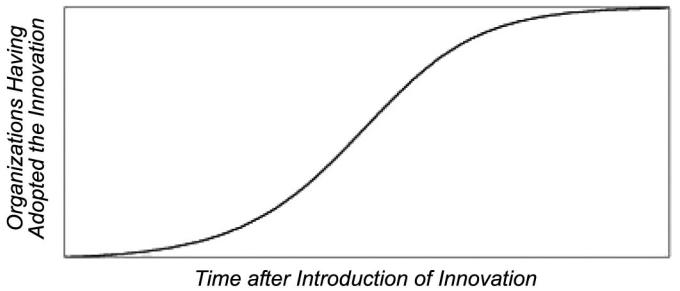

Figure 3.
A standard bass curve for diffusion of innovations over time

Needs analysis has been established as an important first step in an IC or knowledge management exercise (APQC, 2000; Swanstrom, 2001; Von Hippel, 2001). However, its perceptual nature can lead to subjective bias and there is a need to integrate it with other systems and process measures as well as financial analysis, in order to estimate the effectiveness of needs analysis exercises.

3.1.2 Cultural analysis. The success of any KM initiative depends upon an environment which motivates people to communicate, collaborate, innovate, take risks, and share and re-use knowledge. Equally important are appropriate skills, competences and behaviours. Fundamentals like values, trust, beliefs and organizational politics dictate success or failure of KM interventions, so to add real value, the KM initiative must address the existing corporate culture and sub-cultures. Social processes and organizational structures (including self-forming groups) facilitate the conversion of information to knowledge, and the sharing, distribution and creation of knowledge. Other social processes like change management, managing complexity, communities of practice/interest, organizational learning, narrative, visioning etc. are also important and need to be accounted for in KM interventions (Davenport and Prusak, 1998; Guerteen, 1999).

Sustained knowledge management requires the establishment of an organizational memory that is flexible and adaptive to changing requirements. This is best achieved by a strong organizational culture that emphasizes knowledge sharing by the use of various communication channels (Lemkin, 2000). An analysis of knowledge culture is thus recommended.

The results from the analysis of knowledge culture might show cultural barriers that need to be addressed. A supportive environment is the most critical factor for the success of KM projects (Davenport and Prusak, 1998) and should be given high priority.

The cultural factors affecting organizational change have been undervalued, and cultural/behavioristic implementations have shown some benefits. But the cause-effect relationship between cultural strategy and business benefits is not clear, because the "Hawthorne Effect" may come into play, and because we still cannot make dependable predictions about systems as complex as knowledge-based business organizations. Positive results achieved by cultural/behavioristic strategies may not be sustainable, measurable, cumulative, or replicable (Barclay and Murray, 1997).

3.1.3 Commitment measures. Commitment to IC development and knowledge sharing are essential for the success of any knowledge management initiative. Commitment needs to be both attitudinal and behavioral. A high employee and management commitment will result in increased leverage of knowledge. Quinn and Sydney (1996) defined IC as commitment $\times$ competence and emphasized on the importance of commitment for IC development. Building commitment involves engaging employees' emotional energy and attention. It is reflected in how employees relate to each other and feel about a firm (Ulrich, 1998).

Theory and research from literature provides a framework for understanding employee commitment behaviors (Ulrich *et al.*, 1989). Research indicates that employees perception of demands versus the available resources, affects their coping and commitment behaviors. Imbalance of demands and resources results in low commitment behaviors (Hamel and Prahalad, 1994). Once demands and resources are balanced, employees can contribute. They are committed to improve and competent

enough to make the right improvements. Their intellectual capital increases (Ulrich, 1998).

Commitment may be measured along the following criteria.

- Is there an expressed positive attitude towards the project?
- Are positive commitment behaviors exhibited?
- Are value adding behaviors exhibited? Such as initiative taking behaviors, contributions to IP/IC, knowledge sharing and problem-solving, etc.

3.2 Perceptual-process metrics

Perceptual-process metrics refer to measurement techniques that combine process measurements with employee perceptions of their effectiveness. Perceptual-process measures are more enhanced and holistic than traditional perceptual measures. They can be used as diagnostics. Perceptual-process measures are, however, limited to measures of process improvements and do not provide definitive social or financial implications. The goal question metrics, usability statistics, human capital knowledge value added are some of the perceptual-process measures we discuss in this paper.

3.2.1 Goal/question/metrics paradigm. GQM is a widely used perceptual framework for measuring IC, that is process oriented and focuses on diagnostics and deliverables and is used to determine process efficiency (Basili and Perricone, 1984). The GQM approach involves experts and involves three steps: defining goals for the desired state of knowledge management in a specific domain, defining questions on processes and finally defining metrics. GQM defines the goal of measurement in concise terms using five facets: analysis of object (process/product under study), purpose, focus (quality attribute of the object, e.g. reliability), viewpoint and environment (context). The goals are translated into specific questions, which allow a verification of success. Questions are refined through suitable metrics, thus making it possible to control the success of the process. The metrics for each question are defined by asking for information specific to the question. Data collection procedures are defined for each metric. Data are then collected, validated and analyzed and feedback provided to the process team.

The GQM model helps in integrating knowledge management with organizational processes, provides assistance in performing knowledge management activities, comparison of knowledge management processes for designing interfaces between virtual teams and also for inter-organizational knowledge transfer. The GQM framework tracks how the KM system reaches the goals and monitors the processes in detail.

The limitations of the GQM model are that it is process focused and does not address people issues or financial outcomes. A potential danger is the possibility of making KM include too much formalism. The process-oriented view is confusing as it deals with several knowledge domains. While knowledge domains are a means of splitting this complexity, the linking between them is important. KM can only be fully effective when knowledge flows are enabled across organizational divisions or units. Further, the value addition provided through the specific process improvements is not measured in monetary terms or linked to organizational performance.

3.2.2 Usability statistics. Usability statistics refer to the ease of usage of processes and technologies for IC leverage and knowledge management. The measurement criteria according to Ginchereau *et al.* (1997) include the following.

- Performance: refers to ease of implementation, ease of maintenance, ease of administration, ease of analysis and usage, ease of information transfer, dissemination and distribution.
- Documentation: refers to technological support provided by the tool to facilitate documentation.
- Technical support: refers to the availability of technical support staff for clarifications and maintenance.

3.2.3 Human capital knowledge value addition. Human capital knowledge value addition (HCKVA) is a perceptual-process measurement technique that is used to determine the organizational factors that contribute to employee performance. It acts as a diagnostic and can be used to monitor process change and enhancements, to develop human capital potential. Ability development, quitting consequences, knowledge access and rewards were identified as the most important determinants of employee value addition. The limitation of this measure is that it does not link performance behavior and processes to financial outcome measures.

3.2.4 Systems performance measures. System performance measures are broadly divided into two categories, system, and output measures System metrics measure the general health of the system. For example, number of page hits, number of visitors, response times. Output measures are core day-to-day activity measures. Example, turn around time, percent complete on time, turn over rate, retention.

Systems measures contain too much detail and may not always explain the behaviors. They measure a part of the "what", but not much of the "why". Systems measures do not determine the means to create customer value, or how internal knowledge assets improve that value.

3.2.5 Skandia navigator. Skandia is considered to be the first large company to have made a truly coherent effort at measuring knowledge assets (Bontis, 1996; Huseman and Goodman, 1999). The navigator has four areas of focus: process, customer, financial, renewal and development and human capital (Edvinsson and Malone, 1997). The Skandia model uses 91 IC metrics plus 73 traditional metrics to measure the five focus areas mentioned above (Bontis, 2001). Edvinsson and Malone (1997) acknowledge that various IC indices may be redundant but still recommend 112 measures in the navigator. The Skandia model does not assign a dollar value to IC, but uses proxy measures to track trends in assumed value added (Lynn, 1998). The metrics used are subjective in nature and cannot be generalized (Roos and Roos, 1997). They also emphasized that the balance sheet approach followed by the Skandia model results in a snap shot view and does not represent the dynamic knowledge flows in an organization.

Financial measurement systems do overcome problems of subjective bias and reliability. We present key financial measures and their limitations in the next section.

3.3 Financial measures

Financial measures as discussed in Section 1.3.1 focus on the financial outcomes of IC investment. Some examples of financial measurement techniques are the intangibles assets monitor, economic value added (EVA), the knowledge capital valuation method, knowledge production function, return on investment and knowledge value potential.

Sveiby's intangibles assets monitor scorecard approach presents three distinct indicators of IC: external and internal structure, and individuals' competence.

The indicators examine growth, renewal, efficiency, and stability/risk in each of these categories. External structure consists of relationships with customers and suppliers, brand names, and reputation. Internal structure consists of patents, concepts, models, systems and culture. These are created by the employees and are thus generally "owned" by the organization. Individual competence is people's ability to act in various situations. It includes skill, education, experience, and values.

The IAM method provides a scorecard of the company's intellectual capital strengths and weaknesses. However, it does not result in an overall quantifiable value. Sveiby assumes that IC and financial outcomes are innately related. Lynn (1998) argues that value creation is not possible without appropriate support for financial feedback systems and more importantly a supportive culture. IAM does not provide quantitative measures of IC value addition or ROI.

Economic value added is a comprehensive performance measure, proposed by Stewart (1997), that uses the variables of capital budgeting, financial planning, goal setting, performance measurement, shareholder communication, and incentive compensation to account for all ways in which corporate value can be added or lost (Bontis, 1999). In simple terms EVA is a measure of surplus value created on an investment.

EVA is calculated by subtracting capital charges, taxes and operating expenses from the net sales. Capital charges refer to the charges generated on an asset over a period of one year. Operating expenses are the money expended on running the operation for a period of one year. Net sales refer to the total volume of sales in a given financial year. The formula for calculating EVA is presented in equation (1).

$$\text{Net sales} - \text{operating expenses} - \text{taxes} - \text{capital charges} = \text{EVA} \qquad (1)$$

EVA does not add to the understanding of the organizations intangible resources or their specific contributions to the organizations effectiveness. EVA uses 164 areas of performance adjustments, leading a trade off between complexity, accuracy and ease. The large list of possible variables for EVA measurement make it nonstandard and difficult to compare. There is little conclusive empirical evidence on the accuracy of EVA measures.

Price to book value. The most common method for measuring knowledge assets is to subtract a company's book value from its market value and arrive at its IC worth. The price to book ratio compares two different types of valuations:

(1) the stock market's valuation as reflected in the stock's price, and

(2) the accountant's valuation as measured by book value.

Specifically, the price to book ratio is market capitalization divided by shareholder's equity. The shortcoming of the "market to book value" method is that the number rises and falls with market exuberance (Starssman, 1999).

Knowledge capital scorecard method proposed by Lev (2000) is performance driven and makes it possible to assess the worth of organizational knowledge. The value of IC is dependent on the earnings of the organization and accounts for earnings from intangible assets. The difference between the total earnings and earnings from tangible assets is termed knowledge capital earnings (KCE). The knowledge capital is then calculated by dividing the earnings by an expected rate of return on knowledge assets. The formula for calculating knowledge capital value (KCV) is shown in equation (2).

$$\text{KCV} = \text{normalized earnings} - \text{earnings from tangible assets} / \text{knowledge capital discount rate} \quad (2)$$

where normalized earning refers to: earnings adjusted for cyclical ups and downs in the economy; earnings from tangible assets refers to the financial earnings; and knowledge capital discount rate refers to average after-tax profits of: software and biotechnology industries – 10.5 percent. By inserting it in the formula, one can put a dollar figure on a company's knowledge capital.

The strength of the method is its predictive capacity. Empirical studies show a strong correlation 0.53 between return from stocks and knowledge earnings (Stewart, 2001). Another study in the chemical industry, spanning over 83 companies and 25 years, shows that R&D investments returned 25.9 percent pre-tax, whereas capital spending earned just 15 percent. The major drawback of the knowledge capital valuation method is that the variables measured by the Knowledge Capital Valuation method are futuristic.

The knowledge production function refers to knowledge measured by R&D investment and patents. Knowledge production function is the relationship of investment in knowledge capital towards the reduction of production costs and increased economic growth. Machlup (1962) defined knowledge production as any human activity that is effectively designed to create, alter, confirm a meaningful appreciation, awareness or cognizance of one's own or others experiences or ideas. Knowledge production function is measured as a function of the sum total of individual knowledge and learning the organizational knowledge and is described in equation (3).

$$Q = f(K, L, \text{Kn} = f(K, L)). \quad (3)$$

where, K refers to natural knowledge; L refers to learning; and Kn = organizational knowledge.

The knowledge production function is the most basic and fundamental metric towards measurement of the value of organizational knowledge. However, it does not answer the fundamental question "will it make money?" Philips proposed the return on investment measure monitor the economic returns from a knowledge investment.

Return on investment refers to a systematic means to determine a monetary figure to how results compare to costs. ROI is used for evaluating IC investments as profitable. An example being training.

ROI is calculated as a percentage of the ratio between the net benefits derived from a process or knowledge system and the total costs expended and is shown in the equation (4).

$$\text{ROI } \% = \frac{\text{Net benefits}}{\text{Total costs} \times 100}. \quad (4)$$

ROI measures help determine the value of the contribution of a process, system or individual, prioritize programs, improve processes and focus on results. ROI measures can also be used for enlisting management support and changing employee perceptions. However, ROI measures are expensive and time-consuming.

The next section describes measurement techniques that are used to understand the effect of social factors and are classified as "other techniques" for the purpose of this paper.

3.4 Other measures

Other measures refer to a variety of measurement techniques that do not fall under the classification of perceptual, process or financial. They include measures of social networks, econometrics measures like learning and diffusion curves, and knowledge value potential measures.

Social outcome measures refer to processes and social networks which affect knowledge sharing and generation. These include social network measures, ROI of communities of practice, learning curves, diffusion curves, etc.

Social network measures refer to measures of interpersonal networks and authority structures (Carley *et al.*, 2000; Galbraith, 1973; Thompson, 1967). Examples of social network measures are presented below:

Span of control: average number of lower links per manager

Density: the number of actual links in a network divided by the number of all possible links in the network

Density = NN/S ij where $i = 1$ $j = 1$

Cognitive load is a measure of commitment network.

Cognitive load is a measure of commitment network.

Cognitive load: defined for each person

Number of people person i interacts with/total number of people in the group;

Number of resources person i manages/total number of resources

Number of tasks person i is assigned to/total number of tasks

sum of number of resources required by the tasks person i does/(total number of tasks * total number of resources)

sum of number of people who do the same tasks person i does/(total number of tasks * total number of people)

sum of negotiation needs person i needs to do for each task/total possible negotiations

Resource load: average number of resources each individual has access to.

Skill complexity is a product of the number of people and number of available Social and interpersonal network measures determine intangible resources allocation and utilization in the organization and affect the rate of innovation in an organization.

Rate of innovation can be measured based on the time taken from invention to replacement of an old technique and the value added by the new technique (Swanstrom, 2001).

Learning costs associated with new technologies and innovations can be reduced through effective processes. Reduction in learning costs can be measured through learning curves. The learning curve represents natural knowledge production cost reduction without intervention (Abernathy and Wayne, 1974).

Organizations can reduce learning costs and increase diffusions through use of efficient knowledge management systems. Learning and diffusion curves should be applied to knowledge management tools and processes to determine the value add created by them (Watkins, 2001).

Diffusion curves track the diffusion and adoption of new ideas, processes, and products, i.e. Innovations and are based on aggregates of people. A small number of early adopters evaluate and accept an innovation, which then spreads rapidly across the organization (Nielsen, 1995).

The curve typically has an S shape and is called the S curve as a result (Mahajan *et al.*, 1990). Figure 3 presents the diffusion curve.

Many factors, including, opinion leaders, knowledge base, adoption of another innovation, ability to forget the innovations being replaced and technology, govern the rate of diffusion.

Diffusion may be measured using the formula presented in equation (5).

$$N_t = N_{t-1} + p(m - N_{t-1}) + q\frac{N_{t-1}}{m}(m - N_{t-1}) \tag{5}$$

Where, m is the market potential, the total number of people who will eventually use the product, is the p the coefficient of external influence, the likelihood that somebody who is not yet the using the product will start using it because of mass media coverage or other external factors, q the coefficient of internal influence, the likelihood that somebody who is not yet using the product will start using it because of "word-of-mouth" or other influence from those already using the product.

Managers intervene to compress the diffusion curve by conducing a cultural change, economic analysis and knowledge base analysis of the opinion leaders and then design an intervention to address the individual preferences for the packaging of innovations and the packaging of the knowledge. Increasing perceptions of a relative advantage and cost savings can influence diffusion of an innovation.

The next step in the evolution of IC measurement factors in the potential value of knowledge.

Knowledge value potential. Paul Iske in 2001 proposed a measure of knowledge value potential, which helps in making investment decisions and planning for IC growth.

Iske defines the value of knowledge as the difference between the value of the end-state and that of the original state. The original state refers to the context in which knowledge is being measured and the transition process is the end state. The primary thesis being that value of knowledge is context dependent.

Knowledge value potential equals the sum of the probability that knowledge is related to a context, and is multiplied by the ease of transfer and the ease of usage and context specific value addition and is shown in equation (6).

$$\begin{aligned} V_{\mathrm{P}}(K(\Omega)) = \sum_{l} \Big\{ & \pi(K(\Omega), \Gamma)\, \rho(K(\Omega), \Gamma)\, \alpha(K(\Omega), \Gamma)\, V(K, \Gamma) \\ & + \sum_{i} \Big[V_{\mathrm{P}}\Big(L_i^{\Gamma}(K(\Omega), \Omega_i)\Big) - I\Big(L_i^{\Gamma}(K(\Omega), \Omega_i)\Big) \Big] \Big\} \end{aligned} \tag{6}$$

Knowledge value potential can be directly applied to KM systems such as yellow pages, smart documents. The effective exchange between two persons must be measured according to the presence of trust, communication skills, language (barriers) motivation, the prevalence of not-invented-here syndrome and shared mental models. The success of a knowledge management system depends heavily on these issues. The identification, transfer and activation of knowledge across contexts determines the

value added. Hence, the value of knowledge is not the intrinsic property of an organization but is dependent on the environment and the objectives of the measurement. Knowledge potential is context dependent and affected by social factors, interaction and sharing behaviors.

4. The proposed framework

Perceptual, financial, process and other techniques of IC measurement were discussed in the previous section and a clear need established for an integrated holistic framework for IC measurement that combines elements of perceptual, process, financial and social impact of IC. We present an IC measurement framework that addresses issues of organizational growth and economic success.

Rather than follow the general definition of IC given above, we restrict ourselves for the purposes of the study to the OECD definition of IC, which describes IC as "the economic value of two categories of the intangible assets of a company: organizational and human capital" (OECD, 1999). We discuss in detail, measurement frameworks for human and organizational capital, thus capturing the people, process and technology aspects of IC valuation. Customer capital or social networks are only captured via debriefing forms, to include social IC valuation, albeit to a limited degree. In addition, we include financial measures to correlate the traditional OEC framework with bottomline performance measures.

We propose a three-step model for IC measurement. The three steps include: identification and awareness, systems and output measures, and outcome measures of tangible financial returns (Figure 4).

4.1 Knowledge management readiness: the first step towards measurement of IC

KM awareness measures the organizations awareness and readiness for knowledge management, the extent of employee and management involvement, identifies core-competencies and establishes knowledge criticality. This step also includes culture audits.

Systems and process are the diagnostic stage, where current system and process effectiveness is measured. This includes existing frameworks such as the goal-question paradigm and process efficiency measures as well as usability statistics.

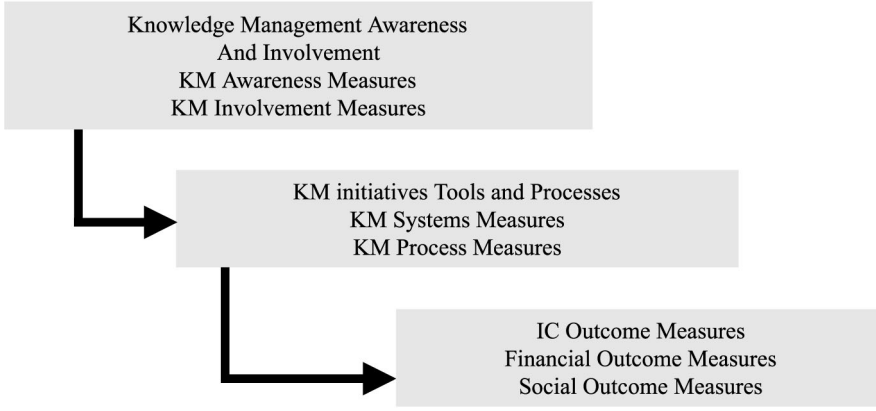

Figure 4.
The new paradigm – a three-step process oriented approach to IC valuation

This step involves current status assessment and indicators for future enhancement or change. The processes and systems are then linked to basic effectiveness standards and financial and social outcomes in the next step.

The IC outcome measures link the various organizational processes and systems to specific financial and social outcomes. These measures can be at two levels: the project level or the global organizational level. They include measures of ROI, ROA, knowledge productivity function, learning curves, etc. Detailed descriptions of each step and analysis are not within the scope of this paper.

Note

1. A knowledge intensive organization is one in which experts make up at least one-third of the organization (Starbuck, 1996).

References

Abernathy, W.J. and Wayne, K. (1974), "Limits of the learning curve", *Harvard Business Review*, Vol. 52 No. 5, pp. 109-19.

APQC (2000), *APQC's Best-Practice Report: Successfully Implementing Knowledge Management*,.

APQC (2001), *APQC: The Leading Edge of Knowing*, American Productivity and Quality Center.

Argyris, C. (1982), *Reasoning, Learning, and Action: Individual and organizational*, Jossey-Bass, San Francisco, CA.

Bagelieri, E. (1997), "R&D performance measurement: a reference model", 7th international Forum on Technology Management, Kyoto.

Bagelieri, E. (2000), "Linking share holder value to R&D Performance", IAMOT Conference, Miami.

Barclay, R.O. and Murray, P.C. (1997), *What is Knowledge Management*, available at: www.media-access.com/whatis.html

Basili, V.R. and Musa, J. (1991), "The future engineering of software: a management perspective", *IEEE Computer*, Vol. 24 No. 9, pp. 90-6.

Basili, V.R. and Perricone, B.T. (1984), "Software errors and complexity: an empirical investigation", *Commun. ACM*, Vol. 27 No. 1, pp. 42-52.

Basili, V.R., Daskalantonakis, M. and Yacobellis, R. (1994), "Technology transfer at Motorola", *IEEE Software*, Vol. 11 No. 2, pp. 70-6.

Becker, G. (1992), *Economic Way of Looking at Life*, Nobel Lecture, 9 December.

Bhatt, G.D. (2000), "Organizing knowledge in the knowledge development cycle", *Journal of Knowledge Management*, Vol. 4 No. 1.

Bontis, N. (1996), "There's a price on your head: managing intellectual capital strategically", *Business Quarterly*.

Bontis, N. (1999), "Assessing knowledge assets: a review of the models uses to measure intellectual capital", *International Journal of Management Reviews*, Vol. 3 No. 1.

Bontis, N. (2001), "Assessing knowledge assets: a review of the models used to measure intellectual capital", *International Journal of Management Reviews*, Vol. 3 No. 1, pp. 41-60.

Brennan, B. (1999), "Measuring and reporting intellectual capital", available at: www.oecd.org

Carley, K.M., Yuqing, R. and David, K. (2000), "Measuring and modeling change in C 3 I architecture", *Proceedings of the 2000 Command and Control Research and Technology Symposium*, Naval Postgraduate School, Monterey, CA.

Celemi (1999), *Growing A Knowledge Company*, available at: www.celemi.com, site includes celemi intangible assets monitor.

DATI – Danish Agency for Trade and Industry (1998), *Intellectual Capital: A New Tool for Companies*, DTI council, Copenhagen.

Davenport, T.H. and Prusak, L. (1998), *Working Knowledge: How Organizations Manage What They Know*, Harvard Business School Press, Cambridge, MA.

Denison, D.R. (1982), "The climate, culture, and effectiveness of work organizations: a study of organizational behavior and financial performance", Doctoral dissertation, University of Michigan.

DeLong, D. (1997), "Building the knowledge-based organization: how culture drives knowledge behaviors", Working Paper, Ernst & Young's Center for Business Innovation, Boston, MA.

Edvinsson, L. and Malone, M. (1997), *Intellectual Capital*, HarperCollins Publishers, New York, NY, p. 225.

Edvinsson, L. and Sullivan, P. (1996), "Developing a model for managing intellectual capital", *European Management Journal*, Vol. 14 No. 4.

Galbraith, J.R. (1973), *Designing Complex Organizations*, Addison-Wesley, Reading, MA.

Ginchereau, W., Howell, F. and Mitchell, K. (1997), "Too much information", *InfoWorld*, 19 May, pp. 72-82.

Guerteen, D. (1999), *Creating a Knowledge Sharing Culture*, available at: www.guerteen.com

Hamel, G. and Prahalad, C.K. (1994), *Competing For The Future*, Harvard Business School Press, Boston, MA.

Huseman, R.C. and Goodman, J.P. (1999), *Leading with Knowledge: The Nature of Competition in the 21st Century*, Sage, London.

Hylton, A. (2002), *The Pivotal Role of the Knowledge Audit*, Knowledge Board, 30 August, available at: www.knowledgeboard.com

IASC (1998), *IAS 38, Intangible Assets*, IASC Standards.

IFAC (1998), *The Measurement and Management of Intellectual Capital : An Introduction*, Financial and Management Accounting Committee IFAC 1998 Study 7.

Iske, P. and Boekhoff, T. (2001), "The value of knowledge doesn't exist: a framework for valuing the potential of knowledge", *Knowledge Management Magazine*, 26-28 June, Vol. 5 No. 2.

Kannan, G. and Akhilesh, K.B. (2002), "Human capital knowledge value addition: a case study in info-tech", *Journal of Intellectual Capital Management*, Vol. 3 No. 1.

Kaplan, R.S. and Norton, D.P. (1992), "The balanced scorecard – Measures that drive performance", *Harvard Business Review*, pp. 71-9.

Kaplan, R.S. and Norton, D.P. (1996), *The Balanced Scorecard*, Harvard Business School Press, Cambridge, MA.

Lam, A. (2000), "Tacit knowledge: organizational learning and innovation", DRUID working paper, Aalborg.

Lemkin (2000), available at: http://citeseer.nj.nec.com/254502.html

Lev, B. (2000), *New Math for a New Economy*, available at: www.bayacht.com/resource/business/busvalue.htm

Lynn, L.E. (1998), "Managing intellectual capital: the issues and practice", Management Accounting Issues, Paper 16, Management Accounting Practices Handbook, Hamilton, Society of Management Accountants, Ontario, Canada.

McGrath, M.E. (1996), "Stetting the pace in product development", *A Guide To Product & Cycle Time Excellence*, Butterworth & Heinemann, London.

Machlup, F. (1962), *The Production and distribution of Knowledge in the United States*, Princeton University Press, NJ.

Mahajan, V., Muller, E. and Bass, F.M. (1990), "New product diffusion models in marketing: a review and directions for research", *Journal of Marketing*, Vol. 54 No. 1.

Nielsen, A.P. (1995), Proceedings from the 3. IPS Junior Workshop on the New Organisation, 25-16 October, Copenhagen, IPS working-paper.

Nonaka, I. and Konno, N. (1998), "The concept of 'Ba': building foundations for knowledge creation", *California Management Review*, Vol. 40 No. 3.

OECD (1999), *OECD Work on Measuring Intangible Investment, Micro Policies for Growth*, OECD, Amsterdam.

Phillips, J.J. (1997), *Return on Investment in Training and Performance Programs*, Gulf Publishing Company, Houston, TX.

Prusak, L. (1998), *Working Knowledge: How Organizations Manage What They Know*, Harvard Business School Press, Cambridge, MA.

Quinn, P.A. and Sydney, F. (1996), *Managing Professional Intellect : Making the Most the Best*, Harward Business Review, March-April.

Roos, G. and Roos, J. (1997), "Measuring your company's intellectual performance", *Long Range Planning*, Vol. 30 No. 3, pp. 413-26.

Roth, A. (1995), "Introduction to experimental economics", in Kajel, J. and Roth, A. (Eds), *Handbook of Experimental Economics*, Princeton University Press, NJ.

Schein, E.H. (1996), "Three cultures of management: the key to organizational learning", *Sloan Management Review*.

Sprotte, K. (2000), K3M, Cegos.

Starbuck, W. (1996), "Unlearning ineffective or obsolete technologies", *International Journal of Technology Management*, Vol. 11, pp. 725-37.

Starssman, P. (1999), "Does knowledge capital explain market book valuations", available at: www.starssmann.com (accessed September 1999).

Stewart, T.A. (1995), "Trying to grasp the intangible", *Fortune*, 2 October, pp. 157-61.

Stewart, T.A. (1997), *Intellectual Capital*, Nicholas Brealey, London.

Stewart, T.A. (2001), "Accounting gets radical", *Fortune*.

Sveiby, K. (1996), *The Knowledge Organisation*, available at: www.sveiby.com.au/KOS1.html

Sveiby, K. (1997), *The New Organizational Wealth: Managing and Measuring Knowledge Based Assets*, Barret-Kohler, San Francisco, CA.

Sveiby, K. (2001), "A knowledge based theory of the firm to guide strategy formulation", *Journal of Intellectual Capital*, Nos 2/4.

Sveiby, K-E. (1998), *What is Knowledge Management?*, report, Community Intelligence Labs, 1 February.

Swanstrom, E. (2001), *Knowledge Management Economics Framework*, GKEC.

Thompson, J.A. (1967), *Organizations in Action*, McGraw-Hill, New York, NY.

Ulrich, D. (1998), "Intellectual Capital = Competence × Commitment", *Sloan Management Review*, Vol. 39 No. 2, pp. 15-26.

Ulrich, D., Wayne, B. and Arthur, Y. (1989), "Human resource competencies in the 1990's: an empirical assessment of what the future holds", *Personnel Administrator*, pp. 91-3.

Von Hippel, E. (2001), "Perspective user tool kits for innovation", *Journal of Product Innovation Management*, p. 18.

Watkins, P.N. (2001), "The persistence of learning and acquisition strategies", *Acquisition Review Quarterly*, October.

West, T. (1999), "The information content of economic value added: a comparitive analysis with earnings cahsflow and residual income", *Journal of Economic Literature*.

Further reading

Myers, P.S. (Ed.) (1996), *Knowledge Management and Organizational Design*, Butterworth-Heinemann, Boston.

Swanstrom, E. (2000), *Knowledge Management: Modeling and Managing the Knowledge Process*, Wiley, New York, NY.