Managing intellectual capital: the MIC matrix

Carla Curado

Department of Management,
ISEG – Economics and Business School,
Technical University of Lisbon,
Rua Miguel Lupi, 20,
Lisboa 1249-078, Portugal
Fax: +351-21-392-28-08
E-mail: ccurado@iseg.utl.pt

Nick Bontis*

DeGroote School of Business,
McMaster University,
DSB #207, 1280 Main Street West,
Hamilton, Ontario, Canada L8S 4M4
E-mail: nbontis@mcmaster.ca
*Corresponding author

Abstract: Knowledge assets represent a special set of resources for a firm and as such, their management is of great importance to academics and managers. The purpose of this paper is to review the literature as it pertains to knowledge assets and provide a suggested model for intellectual capital management that can be of benefit to both academics and practitioners. In doing so, a set of research propositions are suggested to provide guidance for future research.

Keywords: intellectual capital; resource-based view; RBV; knowledge-based view; KBV; knowledge management; knowledge dynamics.

Reference to this paper should be made as follows: Curado, C. and Bontis, N. (2007) 'Managing intellectual capital: the MIC matrix'*, Int. J. Knowledge and Learning*, Vol. 3, Nos. 2/3, pp.316–328.

Biographical notes: Carla Curado is an Assistant Professor at ISEG – Economics and Business School, the Technical University of Lisbon. She holds a PhD in Management and has published in the fields of intellectual capital, knowledge management and organisational learning.

Nick Bontis is an Associate Professor of Strategic Management at the DeGroote School of Business, McMaster University, Canada. He graduated with a PhD from the Ivey Business School, University of Western Ontario. His research interests pertain to knowledge management, intellectual capital and organisational learning. He has won numerous awards for his research and teaching and is recognised as a world-leading keynote speaker and authority on the topic of knowledge management. He is also the Program Director for the World Congress on Intellectual Capital.

1 Introduction

The Resource-Based View (RBV) of the firm is one of the most prominent theoretical perspectives in strategic management (Ahuja and Katila, 2004; Barney, 1991; Eisenhardt and Martin, 2000; Helfat and Raubitschek, 2002; Teece et al., 1997; Wernerfelt, 1984). Central to this perspective is the idea that firms differ in their resource positions, and that such resource heterogeneity is a source of performance variability across firms (Peteraf, 1993). It is largely accepted that the Knowledge-Based View (KBV) of the firm is a recent extension of the (RBV) (Balogun and Jenkins, 2003; Curado and Bontis, 2006; De Carolis, 2002; Grant, 1996; Hoskisson et al., 1999; Huizing and Bouman, 2002; Roos, 1998; Sveiby, 2001). The KBV considers knowledge assets as the most important strategic resources and, in that sense, they warrant critical examination.

The conceptualisation of knowledge as a resource establishes the theoretical connection between the RBV and the KBV of the firm (Malerba and Orsenico, 2000). The notion that unique resources would provide increasing returns was first suggested by Penrose (1959), and then further explored by Rumelt (1984), Foss (1997) and Sveiby (1997). This new perspective is consistent with approaching organisations as cultures. Culture is most repeatedly defined by Schein (1985) as a set of assumptions and beliefs held in common and shared by members of an organisation. Organisational culture represents the stock of knowledge, coded or not, within integrated patterns and routines (Balogun and Jenkins, 2003). As such, the fields of knowledge management, organisational learning and intellectual capital concern themselves with the processes that enable such cultures to be developed.

2 Literature review

There exists a variety of typologies, taxonomies and frameworks that describe knowledge processes in the extant literature (Lytras and Pouloudi, 2006). However, there is still a lack of cumulative theoretical development reflecting the embryonic state of the field. The scientific conception of knowledge in organisations is still in its early stages of development. Although a large and growing body of literature on organisational knowledge, organisational learning, knowledge creation, intellectual capital and knowledge management is emerging, generally speaking, the field is still in its infancy (Bontis and Nikitopoulos, 2001; Bontis et al., 1999; Croasdell et al., 2003; Despres and Chauvel, 2002; Georgopoulos, 2005; Lytras and Sicilia, 2005; Nonaka, 1991; Nonaka and Nishiguchi, 2001; Nonaka and Takeuchi, 1995; Ordonez De Pablos, 2006).

In a comprehensive meta-review of the literature, Serenko and Bontis (2004) state that the fields of intellectual capital and knowledge management have grown dramatically over the last few years with a 50% increase in publications per annum. This is quite remarkable for a nascent field with its earliest academic papers dating from the mid-1990s. Even though the field is considered in its embryonic stages, the concepts are still often referred to as fuzzy (Stewart, 1997, 1998). Notwithstanding, there exists some convergence of what intellectual capital, knowledge management and organisational learning encompass (see Bontis 1999, 2001a,b) for a comprehensive review).

Organisational learning is a dynamic process that occurs through different levels and dimensions within the organisation (Chauhan and Bontis, 1994). A dynamic tension is

created between the process of assimilating new knowledge developed at the individual level (*feed-forward*), and the use of that institutionalised knowledge by individuals (*feedback*). This tension occurs because organisational learning requires various levels of behaviour modification that are in alignment (Bontis et al., 2002; Crossan and Berdrow, 2003; Crossan et al., 1999; Crossan and Hulland, 2002). These two processes are an extension of the ambidextrous view of the firm first presented by March (1991). March (1991) argued that ambidextrous firms were able to balance both the process of exploration and exploitation.

Exploration consists of the development of learning routines that the organisation establishes to create new products and processes. Flexibility, research, risk taking, experimenting and innovation are significant components of this process. Exploitation consists of the development of learning routines that refine these products, processes and preexisting knowledge bases. Choice, production, efficiency, selection, implementation and execution are significant components of this process.

Recall that feed-forward learning flows correspond to learning processes that go from the individual to the organisational level, whereas feedback learning flows represent the impact that organisational-level learning has for individuals. An evident parallelism can be drawn which supports the following two research propositions.

Research Proposition 1: *Feed-forward learning flows correspond to the exploration processes of a firm. This kind of learning involves individual acts of creation, experimentation and innovation, having in perspective the improvisation of future knowledge. This learning flow transforms individual into group and organisational level knowledge.*

Research Proposition 2: *Feedback learning flows correspond to the exploitation processes of the firm. This kind of learning involves the refinement of preexisting knowledge bases and the capability to modify and reuse them. This learning flow transforms from the organisational to the group and individual level.*

There are important implications in balancing the tension between *exploration* and *exploitation*. A firm that manages to innovate and create new businesses and market opportunities, must also be able to execute a strategy that takes advantage of that new opportunity. The problem of balancing *exploration* and *exploitation* is exhibited in distinctions made between the refinement of an existing technology and the invention of a new one (Levinthal and March, 1981; Winter and Szulanski, 2002).

Returns from exploration are systematically less certain, more remote in time and organisationally more distant from the locus of action and adoption. Organisations, through adaptive processes, characteristically improve exploitation more rapidly than exploration. The advantages of exploitation accumulate. Each increase in competence at an activity increases the likelihood of rewards for engaging in that activity, thereby further increasing the competence and the likelihood of rewards (March, 1991). Tallman (2001) presents the following distinction: exploitation generates present rents; whereas exploration originates the capability to generate future rents. Can both strategies be used simultaneously?

Knott (2002) gathered empirical evidence in support of the proposition that combining both strategies reinforces each one of them. There is a complementary effect between the two opposite strategies: exploitation (static optimisation) and exploration (dynamic optimisation). According to the author, firm success in competitive environments involves exploitation of existing firm competencies, while surviving in

dynamic environments involves the exploration of new competencies. Ichijo (2002) presents the dual option as the one involving the use of both strategies to be able to manage in different competitive contexts.

Organisations that choose to focus on one of the strategies generally do not use the other one. According to Bierly and Daly (2002), firms need different kinds of structure, culture and organisational capabilities for each strategy. However, other researchers believe that this is not a one or the other choice, but rather a case of sequencing. For example, during the early stages of the new product development process, a firm may be prospecting for new wealth-creating opportunities. During this discovery period, the exploratory search involves basic research, invention, risk-taking and building new capabilities with the goal of developing new knowledge or capabilities which it can subsequently exploit to create value (Cohen and Levinthal, 1990). Once potentially valuable knowledge and skills have been acquired through exploration, the firm then turns to exploitation activities. Thus, the exploration–exploitation model implies a sequencing for the use of these processes by organisations (Rothaermel and Deeds, 2004). In fact, exploitation cannot, by definition, take place without prior exploration which then goes on to feed exploitation in a reinforcing loop.

In reality, most firms engage in both activities simultaneously because they manage concurrent projects at different stages in the product development process. Yet, from a theoretical viewpoint, the exploration–exploitation model implies that a firm's competency that is currently exploited must have been explored at some earlier time (Rothaermel and Deeds, 2004).

Research Proposition 3: *The processes that lead to direct innovation and commercial success can be attributable to the coordinated sequencing of exploration and exploitation as opposed to the selection of one or the other.*

Firms that successfully coordinate the processes of exploitation and exploration through multiple levels of the organisation are hypothesised to extract the full value of their intangible resources. As such, they are also managing to build their intellectual capital.

3 Managing intellectual capital

The intellectual capital concept was originally developed as an accounting proxy of the difference found between the market and book values of publicly traded firms (Bontis, 1996; Bontis, 2003; Brooking, 1997; Edvinsson, 2000; Joia, 2000; O'Donnell et al., 2004; Pike et al., 2002). The intellectual capital of a firm is a powerful resource (Alvarez and Busenitz, 2001; Bontis, 2002; Cabrita and Bontis, in press; Cleary et al., in press; Cohen and Prusak 2001; Guthrie, 2001; Nahapiet and Ghoshal, 2002; O'Donnell et al., 2006; O'Regan et al., 2001; Seleim et al., 2004; SubbaNarasimha, 2001) that is often recognised as the most valuable and most important asset of the organisation (Stewart, 1997; Wiig, 1997). Intellectual capital is an intangible asset that can be seen as a source of competitive advantage (Birchall and Tovstiga, 1999; Bontis and Fitz-enz, 2002; Caddy et al., 2001; Davenport and Prusak, 2000; Sánchez et al., 2000) for countries as well (Bontis et al., 2000; Bontis, 2004).

Bontis et al. (2002) suggests that intellectual capital represents the 'stock' of knowledge that exists in an organisation. Intellectual capital relates to all organisational knowledge; tacit and explicit; individual and collective. Managing this stock of

knowledge in the firm is the domain of knowledge management theorists (Bontis, 2002; Bontis et al., 2006; Choo and Bontis, 2002). Unfortunately, stock values do not adjust instantaneously, but are accumulated through consistent investments (Ariely, 2003; Bontis and Girardi, 2000; Dierickx and Cool, 1989).

There are a variety of typologies proposed, however, the distinction of human capital, structural capital and relational (customer) capital are most common in the literature and were first evidenced in the mid-1990s (Bontis, 1996; Edvinsson and Sullivan, 1996; Petrash, 1996; Saint-Onge, 1996). Human capital, in a simplified way, is defined as the knowledge embedded in the minds of all employees (Bontis and Serenko, in press). Structural capital consists of the stock of knowledge that stays in the organisation when the employees go home. This consists of all of the non-human storehouses of knowledge contained in databases, filing cabinets, processes and electronic mail (Bontis et al., 2003). Finally, relational capital consists of the knowledge embedded in external networks which consists primarily of knowledge about customers.

The essence of human capital is individual knowledge, the intelligence of each organisational human element. The maximum capacity of human capital is limited to the individual, and reflects the employee's ability to learn and improvise on behalf of its organisation (McKnight and Bontis, 2002; Stovel and Bontis, 2002). Human capital guarantees the inputs to the knowledge creation process (Boisot, 2002). According to Hudson (1993), human capital results from individual's tacit knowledge and can be defined as a combination of four factors: genetic inheritance, instruction, experience and personal attitude. The human capital base contained in high level managers and other specialists may determine organisational success. This will be achieved if human capital is valuable, rare, has no perfect imitation and is not substitutable by any other resource by the competitors (Wright et al., 1994). In this way, it supports Barney's (1991) conditions for sustaining competitive advantage.

However, human capital is the intangible asset that presents the highest mobility (Teece et al., 1997). Once the organisation has integrated human capital with other complementary resources, and it uses that integration to develop organisational competencies, the fact that one or more workers may leave the firm might not imply a loss in competitive advantage. On the contrary, the competitor who acquired that worker would need to access all other organisational resources and systems to fully use the knowledge resources the individual possesses (DeNisi et al., 2003). Structural capital is made up of explicit knowledge and can reflect the causal ambiguity of organisational resources (making it difficult for competitors to imitate). Furthermore, relational capital requires significant investment in market orientation and customer information in order to learn about client desires, tastes and needs. Each of these components on its own is useless. Smart employees (human capital) who know nothing about what customers want (relational capital) cannot convert technology (structural capital) into sustainable advantage. A coordinated investment of all three second-order components of intellectual capital is required to drive business performance (Bontis, 1998).

Research Proposition 4: *A simultaneous coordination of human capital, structural capital and relational capital is required to drive business performance. As individual stocks of knowledge, these subcomponents of intellectual capital are of little value.*

4 The (MIC) matrix

By combining and integrating the elements of the following disciplines: organisational learning, knowledge management and intellectual capital, we propose the MIC (management of intellectual capital) matrix. The matrix encompasses the elements of feed-back and feed-forward learning, the tension of exploitation and exploration, the perspective of multiple levels of analysis and dimensions of intellectual capital (see Figure 1).

A: This matrix represents a longitudinal approach to managing intellectual capital over several phases. We start at point **A** as a brand new start-up organisation. At this stage, our firm is in the exploration phase and we must feed-forward the knowledge embedded within our human capital at the individual level of analysis. To do this, we must recruit the best talent available. By securing the services of researchers and scientists, we may develop knowledge in brand new areas.

B: At point **B**, our matrix sequentially transforms towards the exploitation of individual level knowledge. Here, we are required to implement knowledge management initiatives that allow the firm to extract the talent and competencies embedded in the minds of its employees. In this case, if we suffer from voluntary turnover, we can mitigate the threat through the use of exit interviews and tight controls of knowledge ownership.

C: As we sequentially cycle back to exploration to point **C**, the individual knowledge stocks have now been embedded into organisational resources such as databases and new routines. In aggregate, the firm may now seek out new opportunities for commercial success.

D: The best commercial opportunities become part of the firm's intellectual property portfolio which consists of patent-pending inventions. Here, the firm is now in a position to exploit new market opportunities by harvesting its organisational resources.

E: The external level of analysis provides a customer-centric view of how the intellectual resources may be used to service client needs. This exploratory process yields new ways in which current stocks of knowledge in the firm can be recombined for commercial success.

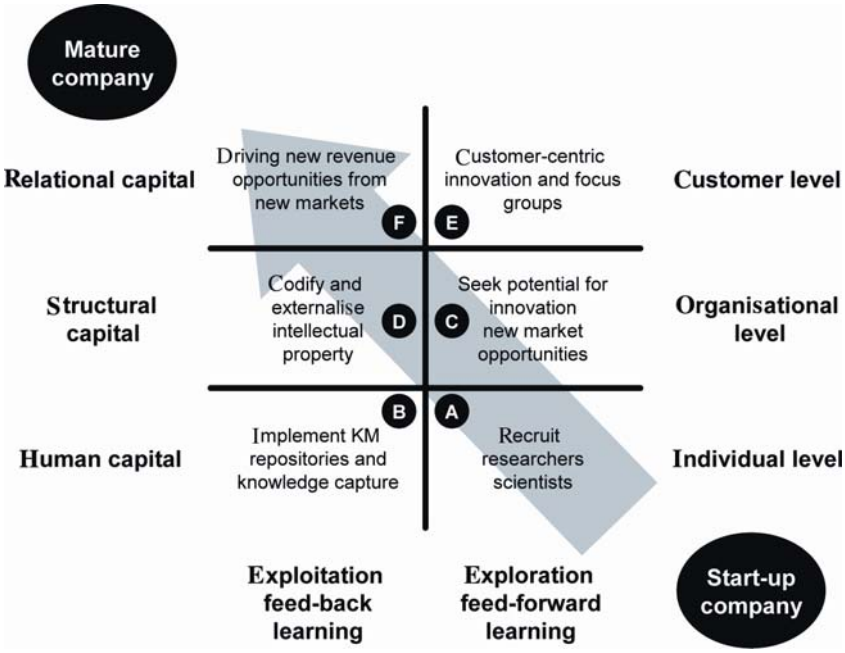
F: The execution of market opportunities yields new products and services that generate sustained economic rents while the knowledge is legally protected. Over time, relational capital is further enhanced as clients coevolve the future development of products and services.

In some cases, a large organisation may have multiple lines of business at different points within the MIC matrix. Successful and/or failing ventures may even fall off the portfolio mix allowing new opportunities to start again at point **A**. This dynamic matrix provides a sequencing of processes that cycle back and forth through the tension of *exploration* and *exploitation* along several levels of analysis.

Each cell within the MIC matrix yields a different set of indices that may be measured and tracked over time. For example, point **A** can be measured using output from HR recruitment. The intellectual capital literature has a long-standing tradition of providing a variety of metrics for human capital as it relates to the capabilities of

individuals. Point **D** can be measured by taking an audit of the portfolio of patents that have been filed. Point **F** can be measured by calculating the proportion of revenue that can be attributable to products and services that have been developed in the last year. One can also measure ratios as a proxy for allocation. For example, by taking **A/B**, one can determine if a firm is spending more of its resources on recruitment versus knowledge management. Depending on the metrics utilised, it may be more prudent to calculate the Eucledian distance in this case (see Appendix for a brief discussion).

Figure 1 The MIC matrix



Furthermore, one can aggregate total sets of figures among rows or columns. For example, the sum of all exploration activities (Σ**A** + **C** + **E**) versus the sum of all exploitation activities (Σ**B** + **D** + **F**). This quotient (or Euclidean distance) would provide a value that addresses the tension between exploration and exploitation.

5 Conclusion

There is a considerable overlap in the scope of intellectual capital, knowledge management and organisational learning. This matrix presents a possibility to fulfil the desire for prescription by transformational leaders (Boehnke et al., 2003; Bontis, 2001a,b). It is an attempt to conceptualise an integrated framework linking disparate literatures together (Reinhardt et al., 2003). We suggest the use of both qualitative and quantitative items that can be used to test a variety of research propositions generated with the MIC matrix as a conceptual lens.

References

Ahuja, G. and Katila, R. (2004) 'Where do resources come from? The role of idiosyncratic situations', *Strategic Management Journal*, Vol. 25, pp.887–907.

Alvarez, S. and Busenitz, L. (2001) 'The entrepreneurship of resource-based theory', *Journal of Management*, Vol. 27, pp.755–775.

Ariely, G. (2003) 'Knowledge management as a methodology towards intellectual capital', *Presented at the 3rd European Knowledge Management Summer School*, 7–12 September, San Sebastian, Spain.

Balogun, J. and Jenkins, M. (2003) 'Re-conceiving change management: a knowledge-based perspective', *European Management Journal*, Vol. 21, No. 2, pp.247–257.

Barney, J. (1991) 'Firm resources and sustained competitive advantage', *Journal of Management*, Vol. 17, No. 1, pp.99–120.

Bierly III, P. and Daly, P. (2002) 'Aligning human resource management practices and knowledge strategies: a theoretical framework', in C. Choo and N. Bontis (Eds). *The Strategic Management of Intellectual Capital and Organizational Knowledge*, New York: Oxford University Press, pp.277–295.

Birchall, D. and Tovstiga, G. (1999) 'The strategic potential of a firm's knowledge portfolio', *Journal of General Management*, Vol. 25, No. 1, pp.1–16.

Boehnke, K., Bontis, N., DiStefano, J. and DiStefano, A. (2003) 'Transformational leadership: an examination of cross-cultural differences and similarities', *Leadership and Organization Development Journal*, Vol. 24, No. 1, pp.5–15.

Boisot, M. (2002) 'The creation and sharing of knowledge', in C. Choo and N. Bontis (Eds). *The Strategic Management of Intellectual Capital and Organizational Knowledge*, New York: Oxford University Press, pp.65–77.

Bontis, N. (1996) 'There's a price on your head: managing intellectual capital strategically', *Ivey Business Journal (formerly Business Quarterly)*, Summer, pp.40–47.

Bontis, N. (1998) 'Intellectual capital: an exploratory study that develops measures and models', *Management Decision*, Vol. 36, No. 2, pp.63–76.

Bontis, N. (1999) 'Managing organizational knowledge by diagnosing intellectual capital: framing and advancing the state of the field', *International Journal of Technology Management*, Vol. 18, Nos. 5–8, pp.433–462.

Bontis, N. (2001a) '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.

Bontis, N. (2001b) 'CKO wanted – evangelical skills necessary: a review of the chief knowledge officer position', *Knowledge and Process Management*, Vol. 8, No. 1, pp.29–38.

Bontis, N. (2002) *World Congress of Intellectual Capital Readings*, Boston: Elsevier Butterworth Heinemann KMCI Press.

Bontis, N. (2003) 'Intellectual capital disclosure in Canadian corporations', *Journal of Human Resource Costing and Accounting*, Vol. 7, Nos. 1/2, pp.9–20.

Bontis, N. (2004) 'National intellectual capital index: a United Nations initiative for the Arab region', *Journal of Intellectual Capital*, Vol. 5, No. 1, pp.13–39.

Bontis, N. and Fitz-enz, J. (2002) 'Intellectual capital ROI: a causal map of human capital antecedents and consequents', *Journal of Intellectual Capital*, Vol. 3, No. 3, pp.223–247.

Bontis, N. and Girardi, J. (2000) 'Teaching knowledge management and intellectual capital lessons: an empirical examination of the TANGO simulation', *International Journal of Technology Management*, Vol. 20, Nos. 5–8, pp.545–555.

Bontis, N. and Nikitopoulos, D. (2001) 'Thought leadership on intellectual capital', *Journal of Intellectual Capital*, Vol. 2, No. 3, pp.183–191.

Bontis, N. and Serenko, A. (in press) 'The moderating role of human capital management practices on employee capabilities', *Journal of Knowledge Management*, Vol. 11, No. 4.

Bontis, N., Crossan, M. and Hulland, J. (2002) 'Managing an organizational learning system by aligning stocks and flows', *Journal of Management Studies*, Vol. 39, No. 4, pp.437–469.

Bontis, N., Dragonetti, N., Jacobsen, K. and Roos, G. (1999) 'The knowledge toolbox: a review of the tools available to measure and manage intangible resources', *European Management Journal*, Vol. 17, No. 4, pp.391–402.

Bontis, N., Fearon, M. and Hishon, M. (2003) 'The e-Flow audit: an evaluation of e-mail flow within and outside a high-tech firm', *Journal of Knowledge Management*, Vol. 7, No. 1, pp.6–19.

Bontis, N., Keow, W. and Richardson, S. (2000) 'Intellectual capital and the nature of business in Malaysia', *Journal of Intellectual Capital*, Vol. 1, No. 1, pp.85–100.

Bontis, N., Serenko, A. and Biktimirov, E. (2006) 'MBA knowledge management course: is there an impact after graduation?' *International Journal of Knowledge and Learning*, Vol. 2, Nos. 3/4, pp.216–237.

Bontis, N. and Serenko, A. (2007) 'The moderating role of human capital management practices on employee capabilities', *Journal of Knowledge Management*, Vol. 11, No. 3, pp.31–51.

Brooking, A. (1997) 'The management of intellectual capital', *Long Range Planning*, Vol. 30, No. 3, pp.364–365.

Cabrita, M. and Bontis, N. (in press) 'Intellectual capital and business performance in the Portuguese banking industry', *International Journal of Technology Management*.

Caddy, I., Guthrie, J. and Petty, R. (2001) 'Managing orphan knowledge: current Australasian best practice', *Journal of Intellectual Capital*, Vol. 2, No. 4, pp.384–397.

Chauhan, N. and Bontis, N. (2004) 'Organizational learning via groupware: a path to discovery or disaster?' *International Journal of Technology Management*, Vol. 27, Nos. 6/7, pp.591–610.

Choo, C.W. and Bontis, N. (2002) *The Strategic Management of Intellectual Capital and Organizational Knowledge*, New York: Oxford University Press.

Cleary, P., O'Regan, P., O'Donnell, D., Kennedy, T. and Bontis, N. (in press) 'Positioning management accounting in the intellectual capital agenda', *International Journal of Accounting, Auditing and Performance Evaluation*.

Cohen, D. and Pruzac, L. (2001) *In Good Company: How Social Capital Makes Organizations Work*, Boston: Harvard Business School Press.

Cohen, W. and Levinthal, D. (1990) 'Absorptive capacity: a new perspective on learning and innovation', *Administrative Science Quarterly*, Vol. 35, No. 1, pp.128–152.

Croasdell, D., Jennex, M., Yu, Z., Christianson, T., Chakradeo, M. and Makdum, W. (2003) 'A meta-analysis of methodologies for research in knowledge management, organizational learning and organizational memory: five years at HICSS', *Proceedings of the 36th Hawaii International Conference on System Sciences (HICSS'03)*, Hawaii, HI: HICSS.

Crossan, M. and Berdrow, I. (2003) 'Organizational learning and strategic renewal', *Strategic Management Journal*, Vol. 24, pp.1087–1105.

Crossan, M. and Hulland, J. (2002) 'Leveraging knowledge through leadership of organizational learning', in C. Choo and N. Bontis (Eds). *The Strategic Management of Intellectual Capital and Organizational Knowledge*, New York: Oxford University Press, pp.711–723.

Crossan, M., Lane, H. and White, R. (1999) 'An organizational learning framework: from intuition to institution', *Academy of Management Review*, Vol. 24, No. 3, pp.522–537.

Curado, C. and Bontis, N. (2006) 'The knowledge based-view of the firm and its theoretical precursor', *International Journal of Learning and Intellectual Capital*, Vol. 3, No. 4, pp.367–381.

Davenport, T. and Prusak, L. (2000) *Working Knowledge: How Organizations Manage What They Know*, Boston: Harvard Business School Press.

De Carolis, D. (2002) 'The role of social capital and organizational knowledge in enhacing entrepreneurial opportunities in high-technology environments', in C. Choo and N. Bontis (Eds). *The Strategic Management of Intellectual Capital and Organizational Knowledge*, New York: Oxford University Press, pp.699–709.

DeNisi, A., Hitt, M. and Jackson, S. (2003) 'The knowledge-based approach to sustainable competitive advantage', in S. Jackson, M. Hitt and A. DeNisi (Eds). *Managing Knowledge for Sustained Competitive Advantage*, San Francisco: Jossey-Bass, pp.3–33.

Despres, C. and Chauvel, D. (2002) 'Knowledge, context and the management of variation', in C. Choo and N. Bontis (Eds). *The Strategic Management of Intellectual Capital and Organizational Knowledge*, New York: Oxford University Press, pp.89–99.

Dierickx, I. and Cool, K. (1989) 'Asset stock accumulation and sustainability of competitive advantage', *Management Science*, Vol. 35, No. 12, pp.1504–1511.

Edvinsson, L. (2000) 'Some perspectives on intangibles and intellectual capital', *Journal of Intellectual Capital*, Vol. 1, No. 1, pp.12–16.

Edvinsson, L. and Sullivan, P. (1996) 'Developing a model for managing intellectual capital', *European Management Journal*, Vol. 14, No. 4, pp.356–364.

Eisenhardt, K. and Martin, J. (2000) 'Dynamic capabilities: What are they?' *Strategic Management Journal*, Vol. 21, pp.1105–1121.

Foss, N. (1997) *Resources, Firms and Strategies: A Reader in the Resource-Based Perspective*, Oxford: Oxford University Press.

Georgopoulos, N. (2005) 'Knowledge management as an integral part of strategic management in e-business era', *International Journal of Knowledge and Learning*, Vol. 1, No. 4, pp.373–387.

Grant, R. (1996) 'Towards a knowledge-based view of the firm', *Strategic Management Journal*, Vol. 17, pp.109–122.

Guthrie, J. (2001) 'The management, measurement and the reporting of intellectual capital', *Journal of Intellectual Capital*, Vol. 2, No. 1, pp.27–41.

Helfat, C. and Raubitschek, R. (2002) 'Product sequencing: coevolution of knowledge, capabilities and products', in C. Choo and N. Bontis (Eds). *The Strategic Management of Intellectual Capital and Organizational Knowledge*, New York: Oxford University Press, pp.317–337.

Hoskisson, R., Hitt, M., Wan, W. and Yiu, D. (1999) 'Theory and research in strategic management: Swings of a pendulum', *Journal of Management*, Vol. 25, No. 3, pp.417–456.

Hudson, W. (1993) *Intellectual Capital: How to Build it, Enhance it, Use it*, New York: Wiley.

Huizing, A. and Bouman, W. (2002) 'Knowledge and learning markets and organizations', in C. Choo and N. Bontis (Eds). *The Strategic Management of Intellectual Capital and Organizational Knowledge*, New York: Oxford University Press, pp.185–204.

Ichijo, K. (2002) 'Knowledge exploitation and knowledge exploration: two strategies for knowledge creating companies', in C. Choo and N. Bontis (Eds). *The Strategic Management of Intellectual Capital and Organizational Knowledge*, New York: Oxford University Press, pp.477–483.

Joia, L. (2000) 'Measuring intangible corporate assets', *Journal of Intellectual Capital*, Vol. 1, No. 1, pp.68–84.

Knott, A. (2002) 'Exploration and exploitation as complements', in C. Choo and N. Bontis (Eds). *The Strategic Management of Intellectual Capital and Organizational Knowledge*, New York: Oxford University Press, pp.339–358.

Levinthal, D. and March, J. (1981) 'A model of adaptive organizational search', *Journal of Economic Behaviour and Organization*, Vol. 2, pp.307–333.

Lytras, M. and Pouloudi, A. (2006) 'Towards the development of a novel taxonomy of knowledge management systems from a learning perspective: an integrated approach to learning and knowledge infrastructures', *Journal of Knowledge Management*, Vol. 10, No. 6, pp.64–80.

Lytras, M. and Sicilia, M. (2005) 'Knowledge society a manifesto for knowledge and learning', *International Journal of Knowledge and Learning*, Vol. 1, No. 1, pp.1–11.

Malerba, F. and Orsenico, L. (2000) 'Knowledge, innovative activities and industrial evolution', *Industrial and Corporate Change*, Vol. 9, No. 2, pp.289–314.

March, J. (1991) 'Exploration and exploitation in organizational learning', *Organization Science*, Vol. 2, pp.71–87.

McKnight, B. and Bontis, N. (2002) 'E-Improvisation: collaborative groupware technology expands the reach and effectiveness of organizational improvisation', *Knowledge and Process Management*, Vol. 9, No. 4, pp.219–227.

Nahapiet, J. and Ghoshal, S. (2002) 'Social capital, intellectual capital, and the organizational advantage', in C. Choo and N. Bontis (Eds). *The Strategic Management of Intellectual Capital and Organizational Knowledge*, New York: Oxford University Press, pp.673–697.

Nonaka, I. (1991) 'The knowledge-creating company', *Harvard Business Review*, November–December, pp.96–104.

Nonaka, I. and Nishiguchi, T. (2001) *Knowledge Emergence: Social, Technical, and Evolutionary Dimensions of Knowledge Creation*, New York: Oxford University Press.

Nonaka, I. and Takeuchi, H. (1995) *The Knowledge Creating Company: How Japanese Companies Create the Dynamics of Innovation*, New York: Oxford University Press.

O'Donnell, D., Bontis, N., O'Regan, P., Kennedy, T., Cleary, P. and Hannigan, A. (2004) 'CFOs in eBusiness: eArchitects or foot-soldiers?' *Knowledge and Process Management*, Vol. 11, No. 2, pp.105–116.

O'Donnell, D., Tracey, M., Henriksen, L.B., Bontis, N., Cleary, P., Kennedy, T. and O'Regan, P. (2006) 'On the 'essential condition' of intellectual capital-labour', *Journal of Intellectual Capital*, Vol. 7, No. 1, pp.111–128.

O'Regan, P., O'Donnel, D., Kennedy, T., Bontis, N. and Cleary, P. (2001) 'Perceptions of intellectual capital: Irish evidence', *Journal of Human Resource Costing and Accounting*, Vol. 6, No. 2, pp.29–38.

Ordonez De Pablos, P. (2006) 'Knowledge flows and learning at inter-organisational level: implications for management in multinational corporations', *International Journal of Knowledge and Learning*, Vol. 2, Nos. 1/2, pp.58–72.

Penrose, E. (1959) *The Theory of the Growth of the Firm*, Oxford: Basil Blackwell Publisher.

Peteraf, M. (1993) 'The cornerstones of competitive advantage: a resource-based view', *Strategic Management Journal*, Vol. 13, pp.363–380.

Petrash, G. (1996) 'Dow's journey to a knowledge value management culture', *European Management Journal*, Vol. 14, No. 4, pp.365–373.

Pike, S., Rylander, A. and Roos, G. (2002) 'Intellectual capital management and disclosure', in C. e Bontis (Eds). *The Strategic Management of Intellectual Capital and Organizational Knowledge*, New York: Oxford University Press, pp.657–671.

Reinhardt, R., Bornemann, M. Pawlowsky, P. and Schneider, U. (2003) 'Intellectual capital and knowledge mangement: perspectives on measuring knowledge', in M. Dierkes, D.R. Antal, J. Child and I. Nonaka (Eds). *Handbook of Organizational Learning & Knowledge*, Oxford: Oxford University Press, pp.794–820.

Roos, J. (1998) 'Exploring the concept of intellectual capital (IC)', *Long Range Planning*, Vol. 31, pp.150–153.

Rothaermel, F. and Deeds, D. (2004) 'Exploration and exploitation alliances in biotechnology: a system of new product development', *Strategic Management Journal*, Vol. 25, pp.201–221.

Rumelt, R. (1984) 'Towards a strategic theory of the firm', in R.B. Lamp (Ed.) *Competitive Strategic Management*, New Jersey: Prentice Hall.

Saint-Onge, H. (1996) 'Tacit knowledge: the key to the strategic alignment of intellectual capital', *Strategy and Leadership*, Vol. 24, No. 2, pp.10–14.

Sánchez, P., Chaminade, C. and Olea, M. (2000) 'Management of intangibles an attempt to build a theory', *Journal of Intellectual Capital*, Vol. 1, No. 4, pp.312–327.

Schein, E. (1985) *Organizational Culture and Leadership*, San-Francisco: Jossey-Bass.

Seleim, A., Ashour, A. and Bontis, N. (2004) 'Intellectual capital in Egyptian software firms', *The Learning Organization: An International Journal*, Vol. 11, Nos. 4/5, pp.332–346.

Serenko, A. and Bontis, N. (2004) 'Meta-review of knowledge management and intellectual capital literature: citation impact and research productivity rankings', *Knowledge and Process Management*, Vol. 11, No. 3, pp.185–198.

Stewart, T. (1997) *Intellectual Capital: The New Wealth of Organizations*, New York: Doubleday.

Stewart, T. (1998) 'Knowledge, the appreciating commodity', *Fortune*, October, pp.199–200.

Stewart, T. (1997) *Intellectual Capital: the New Wealth of Organizations*, New York: NY, Doublebay.

Stovel, M. and Bontis, N. (2002) 'Voluntary turnover: knowledge management friend or foe', *Journal of Intellectual Capital*, Vol. 3, No. 3, pp.303–322.

SubbaNarasimha, P. (2001) 'Salience of knowledge in a strategic theory of the firm', *Journal of Intellectual Capital*, Vol. 2, No. 3, pp.215–224.

Sveiby, K. (1997) *The New Organizational Wealth*, San Franscisco: Berrett-Koehler Publishers.

Sveiby, K. (2001) 'A knowledge-based theory of the firm to guide in strategy formulation', *Journal of Intellectual Capital*, Vol. 2, No. 4, pp.334–358.

Tallman, S. (2001) 'Global strategic management', in M. Hitt, R. Freeman and J. Harrison (Eds). *Handbook of Strategic Management*, Malden, MA: Blackwell.

Teece, D., Pisano, G. and Shuen, A. (1997) 'Dynamic capabilities and strategic management', *Strategic Management Journal*, Vol. 18, No. 7, pp.509–534.

Wernerfelt, B. (1984) 'A resource-based view of the firm', *Strategic Management Journal*, Vol. 5, No. 2, pp.171–180.

Wiig, K. (1997) 'Integrating intellectual capital and knowledge management', *Long Range Planning*, Vol. 30, No. 3, pp.399–405.

Winter, S. and Szulanski, G. (2002) 'Replication of organizational routines: conceptualizing the exploitation of knowledge assets', in C. Choo and N. Bontis (Eds). *The Strategic Management of Intellectual Capital and Organizational Knowledge*, New York: Oxford University Press, pp.207–221.

Wright, P., McMahan, G. and McWilliams, A. (1994) 'Human resources and sustained competitive advantage: a resource-based perspective', *International Journal of Human Resources Management*, Vol. 5, No. 2, pp.301–326.

Appendix

Euclidian distance

The use of the Euclidian distance is suggested for quantifying the proximity, or similitude between two elements x and y. Both variables need to be standardised. The Euclidian distance between two points $X = (a, b)$ and $Y = (c, d)$ is:

$$d_E((a,b),(c,d)) = \sqrt{(a-c)^2 + (b-d)^2}$$

There are several ways to work out the distance between two points in multidimensional space. The purpose of such kind of measures is to give a numerical value to the amount of dissimilarity between two vectors. In the case of the present MIC Matrix, we can benefit from testing the distance among multiple points **A**, **B** or **C** and even the distance among rows (levels of analysis) or processes (exploration versus exploitation).