Knowledge management and the JSE-listed construction sector companies

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1 Introduction

There has been significant agreement over the past ten years and more that knowledge management (KM) strategy and practices can play a significant role in the performance of organizations across a wide range of industries and in many different countries across the globe (Davenport and Prusak 2000; Davenport, De Long and Beers 1998; Davenport, Thomas and Cantrell 2002; Davis and Botkin 1994; Drucker 2000; Gold, Malhotra and Segars 2001; Nonaka 1991; Nonaka and Takeuchi 1995; Ruggles 1998; Rumizen 2002; Senge 1990; Stewart 1997 Stewart, 1998). In particular, there has been some attention paid to

the application of the principles of KM in the construction industry in the popular and academic literature (Barlow and Jashapara 1998; Carillo 1993; Conroy and Soltan 1998; Egbu, Sturgesand and Bates 1999; Kazi 2002; Orange, Burke and Boam 2000; Rezgui 2001; Schapke, Menzel and Scherer 2002; Wetherill 2002; Yli-Renko, Autio and Sapienza 2001). In addition, publications from government and related agencies in, for example, England and South Africa (CIDB 2004; CRISP 2001; Egan 1998; Latham 1994; Van Wyk 2004) have highlighted the role that KM can play in the construction industry.

In South Africa, KM has been the focus of a number of research projects, with SA-based authors having covered subjects such as: surveying, measuring and valuing KM practices (Botha 2004; Botha and Fouché 2002; Kruger and Snyman 2005a; Tobin and Volavsek 2006); the role and influence of corporate culture (Davel and Snyman 2005; Ndlela and Du Toit 2000); KM in SA law firms (Du Plessis and Du Toit 2005); leadership issues (Kok 2003); organizational maturity and world-class performance in relation to KM (Kruger and Snyman 2005b; Tobin and Snyman 2004); strategic perspectives (Snyman and Kruger 2004); KM and organizational structure (Gichuru and Tobin 2004; Tobin and Franze 2005); communities of practice (Van den Berg and Snyman 2003); and KM and the use of enterprise intranets (Van der Walt, Van Brakel and Kok 2004). However, none of these authors has specifically focused their research on the construction industry in SA, which provided an opportunity for the undertaking of this research project, the objective of which was to gain an understanding of the status of KM in the JSE-listed construction sector companies.

2 Background to the research

The research problem was defined from four related perspectives: firstly, the nature of construction industry in SA and its relative importance to the local economy, within the global context; secondly, the opportunities and challenges faced by the construction industry in SA; thirdly, the nature of the relevance of KM to the South African construction industry, within the context of the global industry; and, finally, the profile of the JSE-listed construction sector companies. These four issues were explored in this research.

2.1 SA construction industry in a global context

The relative importance of the construction industry at a global level is not in doubt. The 'construction sector accounts for around one-tenth of the world's gross domestic product, 7% of employment, half of all resource usage and up to 40% of energy consumption' (Aveng 2005:15). The value of the global construction industry reached over US $4 trillion in 2004, where the South African construction industry accounts for about 0,3% of that total. The total income for the SA construction industry in 2004 was estimated at approximately R100,4 billion, with an industry-wide net profit before tax of R3,9 billion. The total number of people employed in the construction industry in 2004 was about 403000, of which 262000 were full-time employees (Statistics South Africa 2005). In the longer term, prospects for the industry will be influenced by the SA government's 2005 medium-term expenditure framework plan (which, excluding parastatals, shows a R165 billion investment programme over the next three years) in areas such as infrastructure projects (Aveng 2005), as well as a number of other significant influences such as the World Cup 2010, the Accelerated and Shared Growth Initiative for South Africa (ASGISA) and the Joint Initiative for Priority Skills Acquisition (JIPSA) (Cockett 2006).

2.2 Opportunities and challenges facing the SA construction industry

The general economic and social environment in SA provides a number of both opportunities and challenges to the industry. The good news, providing a positive stimulus, includes the broad economic situation, such as a more stable currency, historically (in local terms) low interest rates, steady growth and managed inflation, leading to the observation that the 'outlook for construction over the next five years must be the best it has been since the early 80s' (Concor 2005:8). In addition, there is a general recognition of the role and importance of the global economy in the fortunes of the SA construction industry, as expressed by the statement that 'we strive to meet the expectations of our international markets, benchmarking our performance against best-in-class industry standards and our delivery against world-class precedent' (Murray and Roberts 2005:10).

Despite the generally positive outlook for the SA economy in general, and the construction industry in particular, there are a number of challenges to be faced. These include the normal commercial risks such as liquidity, credit, currency fluctuations and general economic instability (Basil Read 2005). More specifically, the industry is faced with other challenges such as a demanding legislative environment and further calls for compliance with the Broad-Based Black Economic Empowerment Act (with a Construction Industry Charter expected in 2006 or 2007) and a shortage of key skills (which JIPSA is intended to address at least in part).

2.3 Relevance of KM to the construction industry

KM has become an increasingly important issue due to rapid changes in the market conditions, competition and technological developments, which have led to changes in work and the way work is organized. KM is considered vital for the survival of organizations. It is asserted that knowledge is fast overtaking capital and labour as the key economic resource in advanced economies (Edvinsson 2000). KM is particularly important for the construction industry, for at least three main reasons. Firstly, the construction industry is widely perceived as an industry with low productivity and poor performance despite its importance in the national economy. Hence, there is a need for KM to improve the existing processes and management of construction companies (CIDB 2004). Secondly, the project-based nature of the industry has made it particularly important to record and transfer lessons from one project to another (Rezgui 2001). Thirdly, construction companies today face various challenges. New solutions are necessary to meet the growing demand for new types of buildings and structures (Egan 1998).

It is widely accepted that the current market dynamics and the trends towards specialized and customer-oriented services in the construction industry demand a more efficient and effective application of knowledge within corporate as well as project organizations (Egbu, Sturgesand and Bates 1999; Orange, Burke and Boam 2000; Schapke, Menzel and Scherer 2002). A number of researchers have acknowledged the limitations of current approaches to managing information and knowledge relating to and arising from a construction project (CIDB 2004; Egan 1998; Egbu *et al*. 1999; Orange *et al*. 2000; Rezgui 2001; Van Wyk 2004). CIDB (2004) states that the lessons learnt in SA construction projects are not organized well and are buried in details. This makes it difficult to compile and disseminate useful knowledge to other projects. The fragmentation of the construction industry has also been identified as a critical barrier to achieving efficient communication among parties (and individuals) within a project team working together on construction projects (Egan 1998; Egbu *et al*. 1999; Latham 1994; Rezgui 2001).

Since engineering and construction businesses tend to be 'project-driven', KM systems need to be designed to collect, disseminate and use project-generated knowledge, for the benefit of the entire organization. For project-generated knowledge, Conroy and Soltan (1998) define three knowledge bases to contain the knowledge that is used and created in the execution of

the project. These are the:

- organization knowledge base, which contains the data and information specific to the organization and wider environment in which the project is being executed;
- project management knowledge base, containing knowledge of the theory and application of project management. This is company specific and is the intellectual capital of the company; and
- project-specific knowledge base, which is the project specific knowledge acquired from the user at the outset and developed over the project life cycle. This is the potential for usable knowledge and it is at the source of much of the knowledge identified above.

Adding to these themes, the project management knowledge base comprises knowledge about personal skills, project experience of the employees and cross-organizational knowledge (Rezgui 2001). In considering the business of construction, the project-generated knowledge that is of interest for capture can be divided into three general categories (Conroy and Soltan 1998):

- Technical – relating to techniques, technologies, work processes, statutory requirements, costs and so forth involved in the production of discipline-specific elements of the project. New knowledge needs to be fed back into and managed by the discipline departments of the organization.
- Project management – relating to the techniques and technologies for managing the execution of projects. This knowledge is of benefit to all project managers and others involved in the wider aspects of project management, including the company quality system.
- Project related – knowledge of the client and the historical aspects of the project, which are of use for future marketing purposes either in winning jobs with the same client or in improving the company's 'curriculum vitae'.

Conroy and Soltan (1998) conclude that by using an integrated KM system, capturing project-generated knowledge is feasible.

2.4 JSE-listed construction industry sector companies

The six listed companies (or in the case of Aveng, the subsidiary that is involved in the construction industry) at the time of the research represented roughly 20% of the total SA construction industry both by number of employees (51500 of 262000 full-time employees based on company annual reports and figures provided by SA government), and 20% of industry revenues (R21.8 billion of total industry revenue of R100.4 billion). All of those enterprises selected also fell into the 'large group size (LGS)' of a company as defined by Statistics SA, as they each had a turnover in excess of R26 million. These six companies also accounted for 58% of the full-time employees in the LGS (Aveng 2005; Basil Read 2005; Concor 2005; Group 5 2005; Murray and Roberts 2005; Statistics South Africa 2005; WBHO 2005). Table 1 presents key attributes of the six companies in the survey, followed by a brief profile of each company.

Table 1 JSE-listed construction sector companies (Source: Annual reports 2004 figures)

	Revenue	No. of employees	Year founded	Year listed
Aveng	R7-billion	18,000	1911	1964
Basil Read	R469-million	1,100	1952	1987
Concor	R1,3-billion	2,100	1954	1981

Group 5	R2,3-billion	11,500	1969	1974
Murray and Roberts	R8,4-billion	16,000	1948	1968
WBHO	R2,4-billion	2,800	1970	1992

2.4.1 Aveng (Grinaker-LTA)
Aveng Group includes Grinaker-LTA, which was formed when Grinaker Construction merged with LTA in 1998. Today Grinaker-LTA is a multi-disciplinary construction and engineering group anchored in South Africa and focused on infrastructure, energy and mining opportunities in Africa and the Middle East. Grinaker-LTA is 75% owned by Aveng Limited, a public company listed on the JSE, and 25% by Qakazana Investment Holdings (Pty) Limited, a black economic empowerment (BEE) company (Aveng 2005).

2.4.2 Basil Read
At the time of the survey, Basil Read was 70% owned by Bouygues Construction (France), with the remaining 30% in public shares listed on the JSE. Basil Read is the smallest (in terms of revenues) of the six construction companies listed on the JSE, and its principal activities are the provision of civil engineering services, road construction, building, housing, facilities management and opencast mining (Basil Read 2005).

2.4.3 Concor
Concor has been a supplier of construction services and building products in southern Africa since 1954. Major projects have included the construction of bridges, offices buildings, hospitals, manufacturing plants and dams. The major shareholder in 2004 was Hochtief AG (Germany), with an offer being received during the year for part of the shareholding to be acquired by Murray and Roberts. That transaction has since been completed (Concor 2005).

2.4.4 Group 5
Group 5 is a broad-based infrastructural company, specializing in multi-disciplinary construction and engineering projects as well as material manufacturing. The Group employs people throughout its operations in Africa, the Indian Ocean Islands, the Middle East, Asia and Eastern Europe. With decades of construction experience, Group 5 has played a major role in the development of southern Africa's infrastructure, achieving a reputation both nationally and internationally for innovation and professionalism (Group 5 2005).

2.4.5 Murray and Roberts
Murray and Roberts is a company that is positioned as a primary contractor in the delivery of mining, infrastructure, building and industrial assets into the market. More than 75% of Murray and Roberts's activity is directed into the construction economies of the less developed world, primarily those of South and sub-Saharan Africa, the Middle East and Southeast Asia (Murray and Roberts 2005).

2.4.6 WBHO
WBHO is principally involved in the following activities: building construction, civil engineering, roads, earthworks and township infrastructure. In 1994, Wilson Bayly Holmes took a strategic interest in Ovcon, which ultimately led to the merging of the two groups now known as Wilson Bayly Holmes-Ovcon. The company has experience of major construction projects in southern Africa, the Middle East and the Indian Ocean islands, and the company is engaged in an expansion programme further into Africa and internationally (WBHO 2005).

3 Methodology

It was established that there had been no previously published formal academic research on KM in the SA construction industry and, given the relative importance of the sector to the SA economy, this seemed to present a fruitful area for investigation. Within the time and budget constraints under which this project was conceptualized and planned, it was decided to limit the scope of this research project to assessing the status of KM in the construction companies listed on the Johannesburg Stock Exchange (JSE) at the time the research was undertaken. The objective of the research was to gain an understanding of the status of KM (as measured by the research instrument) in the JSE-listed construction companies and to provide an analysis of the status of the sector (rather than the individual respondents) as a result. A number of sources were used in the development of the project's research methodology (Hussey and Hussey 1997; Neuman 1997; Saunders, Lewis and Thornhill 2000). The research objectives determined the number of companies to be included in this survey (namely six, those listed in the construction sector of the JSE). In terms of the survey objectives, it was decided to use the questionnaire survey method (in preference to other techniques, such as interviews and focus groups) and it was important to identify knowledge workers in the construction industry as suitable respondents in each of the target companies. For the purposes of this research, knowledge workers were defined as professional people from a number of specialist fields (e.g. engineers, architects, designers, technicians and surveyors) in the target companies. To ensure that the questionnaire reached these kinds of professionals, non-probability sampling was used and these professionals were purposefully selected. Senior management in the six companies were contacted to act as key informants, by referring the researchers to potential candidates who could be targeted to respond to the questionnaires. Snowball sampling was also used (where one respondent identified other potential respondents) to ensure adequate distribution of the questionnaire. A total of 150 questionnaires (25 to each company) were sent to these companies for data collection. Fifty-eight valid questionnaires were returned, indicating a response rate of 39%, an acceptable response rate for this type of research.

Within the time and budget constraints under which this research needed to be completed, it was decided to make use of an existing research instrument. After a preliminary review of a number of possibilities, the 'Know-All 50 questionnaire' (KA50), as designed by (and with approval from) David Skyrme Associates, England, was selected. The questionnaire has a strong pedigree, based on a number of years of research and development (Skyrme 1998, 2000; Skyrme and Amidon 1997, 1998). The respondents were advised to use a ten-point rating scale with three pre-determined ratings (poor performance at the lowest rating, average performance mid-range and excellent performance at the high end of the scale (with discretion to position performance on a discrete basis along the full scale). The high-level KA50 topics are shown in Table 2 (ten groups of five detailed questions in each group).

Table 2 Know-All 50 questionnaire high level topics (Skyrme 2000)

| |
|---|
| 1. Leadership |
| 2. Culture |
| 3. Processes |
| 4. Explicit knowledge |
| 5. Tacit knowledge |
| 6. Knowledge hub and centres |
| 7. Market leverage |
| 8. Measures |
| 9. People or skills |
| 10. Technology infrastructure |

4 Findings and analysis

The results for the valid survey responses were grouped per company and analysed for the JSE-listed construction sector as a whole. To maintain anonymity and confidentiality the names of the companies are not shown and the letter associated with each company score is not significant. Shown on Table 3 are the average KA50 scores for all respondents of each company, as well as the mean for the KA50 question set for the sector as a whole (where each assessment group comprised of five detailed questions scored on a one (lowest) to ten (highest) basis.

Table 3 JSE-listed construction companies KA50 scores

Assessment groups	Company scores						JSE-listed construction sector	
	A	B	C	D	E	F	Arithmetic mean	Standard deviation
1. Leadership	6,3	2,4	3,1	6,2	5,7	4,0	4,62	1,68
2. Culture	6,7	3,5	5,4	6,3	6,8	5,5	5,70	1,23
3. Processes	6,4	2,2	4,8	4,8	6,0	4,7	4,82	1,47
4. Explicit knowledge	6,4	3,1	4,3	6,2	5,1	5,6	5,12	1,25
5. Tacit knowledge	7,3	3,4	5,2	5,8	6,4	5,2	5,55	1,32
6. Knowledge hubs and centres	6,5	1,9	3,2	4,0	4,8	2,8	3,87	1,63
7. Market leverage	6,2	2,2	4,4	4,7	4,5	5,2	4,53	1,32
8. Measures	5,0	2,9	5,5	3,8	5,0	3,8	4,33	0,99
9. People or skills	4,7	2,3	4,0	5,6	6,0	3,1	4,28	1,43
10. Technology infrastructure	6,9	2,9	3,1	7,0	7,0	3,9	5,13	2,04
JSE-listed construction sector average							4,80	0,58

Figure 1 shows the JSE-listed construction sector arithmetic mean in graphical form. This indicates that the sector as a whole achieved low average scores in Knowledge Hubs and Centres (3,87), Measures (4,33), People/Skills (4,28) and Leadership (4,62). The sector scored higher in Culture (5,70) and Tacit Knowledge (5,55) and Technology Infrastructure (5,13). The overall average across the sector in all of the ten factors assessed was 4,80. Analysis of each of the groups of assessment questions follows.

Figure 1 JSE-listed construction sector arithmetic mean scores
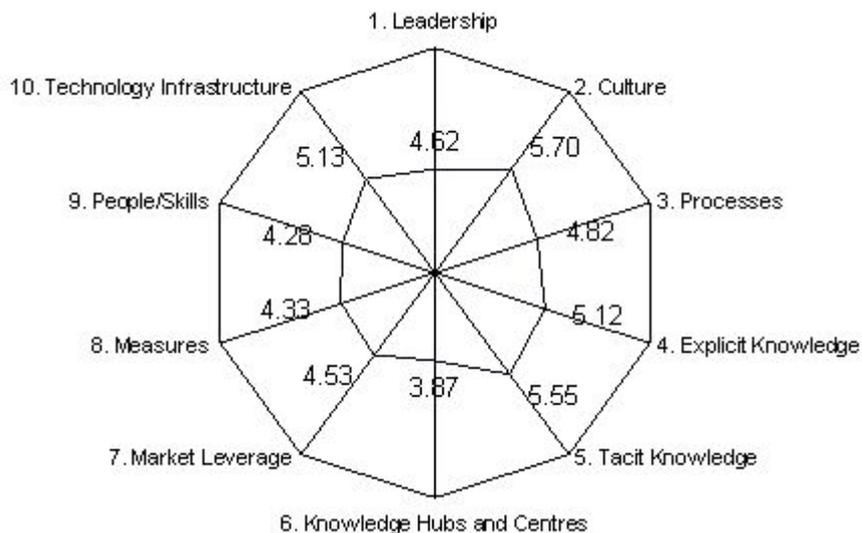
Leadership: Average score for the sector was 4,62. 'A good score indicates that knowledge is seen as strategic and its contribution to the business is clearly articulated; that the organization's structure, culture and environment encourages knowledge development and sharing … knowledge leadership means having a very clear vision of the knowledge contribution to the business, articulating and communicating it well' (Skyrme 2000:online). This was a mid-ranking score with the second highest standard deviation (SD) of scores at 1,68. This indicates no particular capability on the part of the sector as a whole, as well as a relatively large degree of variation in performance within the six companies. It is widely recognized that support from top management is a key driver for any project to be successful in a business context. Top management support typically involves initiating, funding knowledge networks and projects, as well as developing skills to learn from other people. Organizations with successful KM functions are those with appointed senior-level executives to carry out the role of full-time chief knowledge officer (Rumizen 2002). In a similar vein, empirical evidence also shows that employees' perception of top management support of KM activities is critical in the promotion of KM (Martinsons 1995). Moreover, a study by Connelly (2000) surveyed 126 individuals from various industries and supports the importance of the employees' perception of top management and knowledge management. Furthermore, management must communicate that its knowledge responsibilities include nurturing and leveraging of the collective knowledge base for the benefit of the organization.

Culture: Average score for the sector was 5,70. 'Culture stands out as the key factor that determines success or otherwise with knowledge management ... a culture of sharing can be engendered by creating the right attitudes and behaviours' (Skyrme 2000:online). This was the highest score achieved for all of the ten areas assessed, and achieved the second lowest spread of scores (SD was 1,23). Although in absolute terms a score of 5,70 could be regarded as low compared to the maximum, it is encouraging that one of the most difficult issues to tackle in terms of creating a successful implementation scored so highly.

Processes: Average score for the sector was 4,82. 'Organizations [should] therefore look at the range of processes and practices that help both tacit and explicit knowledge transfer' (Skyrme 2000:online). The score for this assessment attribute was in the top half of the ten factors assessed, with a middle-ranking spread at an SD of 1,47. KM investments must be clearly tied to the processes and goals of the organization – reducing costs, increasing profitability, producing better products, accelerating innovation, monitoring the competitive landscape and assuring sustained ability to produce competitive products. Leading companies in all sectors have developed strategies for KM (Rumizen 2002). Rumizen noted that many companies are achieving great success by applying KM philosophies, methodologies and tools. This is certainly the case in the construction industry,

where the potential is largely untapped.

Explicit knowledge: Average score for the sector was 5,12. 'Explicit knowledge is best managed by applying the core principles of information resources management' (Skyrme 2000:online). This assessment area was among the top three scoring items with a relatively low SD of 1,25. This indicated a generally consistent approach to managing explicit knowledge, although still a significant level of performance below the maximum capability. It might have been expected that given the relative maturity of many of the companies surveyed (average date since their establishment is 53 years) that the management of explicit knowledge, with or without the use of IT, might have been more advanced. However, given the indications reported from the literature earlier in this article, the results seem in line with expectations.

Tacit knowledge: Average score for the sector was 5,55. 'There are two general approaches to managing tacit knowledge: converting some of it into a more explicit form, through elicitation and articulation; and creating mechanisms such that informal knowledge exchange can occur when needed' (Skyrme 2000:online). This was the second-highest scoring assessment area, with an average SD of 1,32. In the construction industry it should be expected that tacit knowledge is widespread, as indicated by the literature, but the challenge still exists to convert that knowledge to explicit knowledge and to share and capture that knowledge. KM that results in action depends on tapping the tacit knowledge and subjective insights, intuitions and hunches of individual employees and making these available for testing and use by the whole organization (Davenport and Prusak 2000). The combining of tacit and explicit knowledge improves the use and reuse of current knowledge by developing best practices and creating new knowledge through the revision and destruction of existing knowledge.

Knowledge hubs and centres: The average score for the sector was 3,87. 'A centre aggregates knowledge that would otherwise by dispersed and lack critical mass. They act as a focal point for collection, structuring and disseminating knowledge' (Skyrme 2000:online). This was the lowest scoring area of all ten assessment categories, with, however, the third highest spread of scores between the companies at an SD of 1,63. The importance of the hub is that it can point a knowledge worker to various sources of knowledge without a lot of frustration. Typically, the objective of the initiative is to establish a corporate knowledge base, that is capital structure, for the capture and dissemination of best practices and project-related knowledge. The function of the database is to share insights gleaned from the organization's previous experiences, in the hope that they may find application in future projects in an effort to avoid reinventing the wheel. Projects, processes and case studies are documented with relevant supporting documents. Management challenges in this KM approach are the classification and organization of knowledge or information in a fashion that matches the work needs of people with knowledge held by others and incentivising use of the knowledge base.

Market leverage: The average score for the sector was 4,53. 'Significant additional benefits can be achieved by seeking ways of exploiting knowledge externally. This can be in the form of improved products and services or knowledge-based products and services in their own right' (Skyrme 2000:online). This factor was positioned in the middle of the range in terms of both the average score and SD. As indicated in the background to this study, a number of industry role players have recognized that their capabilities are already moving more towards their intellectual capital rather that physical capabilities (Concor 2005; Murray and Roberts 2005) and their international expansion plans give some practical example of this.

Measures: The average score for the sector was 4,33. 'While most organisations carry out detailed financial measurement and reporting, few do the same for their intellectual and

knowledge assets that are much more valuable' (Skyrme 2000:online). This assessment factor scored in the bottom third of the ten topics, with the lowest overall SD of 0,99. Effective measurement of KM is a challenge in all industries in SA (Kruger and Snyman 2005a; Tobin and Volavsek 2006), so this result confirms expectations. As knowledge workers' productivity creates most of the value in post-industrial industries, an organization's intellectual production will increasingly be taken as a standard to measure the organization's value. Consequently, business and finance regulators have identified the measurement and valuing of intangible assets as one of the most important and challenging issues for today's knowledge-based business.

People or skills: The average score for the sector was 4,28. 'The human resources function has a key role to play in addressing this, for example through reward policies where a growing number of organizations are introducing knowledge creation and sharing as part of an individual's annual appraisal' (Skyrme 2000:online). This was the second lowest ranked of the ten factors, with a mid-ranking SD of 1,43. This must be an area of concern, as the current skills shortage, which SA government is attempting to address in a number of ways (including through JIPSA, as mentioned earlier), represents a potential constraint on the performance of the sector as a whole. If management is interested in knowledge development as a strategic lever, it is necessary to view the knowledge worker's position as central in the company. Research has indicated that most managers have little understanding of how people relate to information (Davenport and Prusak 2000). Consequently, many managers focus on dysfunctional IT solutions, failing to recognize the importance of the human factor in the KM solution.

Technology infrastructure: The average score for the sector was 5,13. 'Information and communications technologies can significantly enhance knowledge activities. Paramount is the overall information and communications network that provides connectivity of people to information and other people' (Skyrme 2000:online). This assessment area achieved the third highest overall score, as well as the highest SD at 2,04, twice the variability associated with the assessment of KM measures. This suggests that although the JSE-listed construction sector scored relatively well in terms of the technology infrastructure to support IT as a whole, and in relation to other issues in the survey, there was a significant degree of variability across the sector. KM implementations often rely on IT support, and although there is a debate about the degree of importance of such technologies, many organizations consider them as very important enablers that support the implementation of a KM strategy (Egbu *et al*. 1999; Skyrme and Amidon 1997) as they often require a significant amount of time, effort and money to use effectively, with the balance devoted to people and organizational culture issues (Davenport and Prusak 1998). Ruggles (1998) explains the importance of IT tools due to their quick evolution, dynamic capabilities and high cost.

5 Conclusions and recommendations

It is interesting to note that there was a much lower variability of the scores across the ten assessment areas (an SD of 0,58) than for the variability associated in terms of the spread of scores between the six sector role players in any one assessment criteria (an SD of 1,44). This indicates that there was more consistency in terms of overall capability in terms of the ten assessment areas than there was for the most consistent individual issue assessed (topic eight, Measures). In addition, no single assessment criterion achieved a score of less than 3,87 (Measures) or more than 5,70 (Culture). In layman's terms that means that the JSE-listed construction sector as a whole had neither an area of absolute failure, nor was there an area with any outstanding strength. This suggests that if the sector were to be compared to other sectors, locally or internationally, the 'term report card' summary might read 'Modest

performance in most areas, a few weaknesses but disappointingly few outstanding aspects worthy of reward. Should try harder.'

Given the findings and analysis presented here as the results of the non-empirical and empirical research, some recommendations for the JSE-listed construction sector companies can be made. The companies surveyed should:

- understand the status of the sector as a whole in terms of its readiness to meet the challenges and opportunities presented in SA and, where appropriate, other geographies in terms of leveraging KM capabilities;
- consider what sector-wide initiatives may be appropriate to improve overall sector performance;
- review individual company performance against overall sector performance in each of the ten assessment areas;
- implement appropriate action plans to improve performance on a prioritized basis;
- evaluate the merits of supporting further research in terms of identifying appropriate solutions to support the priority areas for the sector as whole; and
- set goals for improved performance based on a broad understanding of the overall SA construction industry (not just the JSE-listed sector members) 'best of breed' performance.

The achievement of a number of these recommendations would be well supported by additional research into the status of KM in a number of ways:

- Within the broader SA construction industry (the 80% of the industry excluded from this research);
- a longitudinal study that reassesses the JSE-listed sector members over an extended period of time; and
- an in-depth study of one or more JSE-listed sector members to identify opportunities to identify and share practices that will enhance overall industry competitiveness.

Given the relative importance of the construction industry to South Africa as a whole, it seems important that principles and practices associated with KM should receive significant and continued attention, supported at least in part by the research presented here.

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