

Dinko Herman Boikanyo (South Africa), Ronnie Lotriet (South Africa), Pieter W. Buys (South Africa)

Investigating the use of knowledge management as a management tool in the mining industry

Abstract

The main objective of this research study is to investigate the extent to which knowledge management is used within the mining industry.

Knowledge management includes the identification and examination of available and required knowledge and the subsequent planning and control of actions to develop knowledge assets to accomplish organizational objectives.

A structured questionnaire is used for the study. A total of 300 mines were randomly selected from a research population of mining organizations in South Africa, Africa and globally. The respondents were all part of senior management. A response rate of 64% was achieved.

A significant number of respondents indicates that there is no transfer of knowledge about the best practices within their organizations. Some of the participants indicate that their organizations do not have the required technical infrastructure to enable knowledge sharing whilst some agree that the culture in their organizations is not conducive to the sharing of knowledge.

A statistically and practically significant positive relationship with a large effect is found between the construct of knowledge management and perceived business performance. The mining organizations in Africa are ranked the lowest in terms of applications of knowledge management principles.

Keywords: knowledge, knowledge management, mining industry.

JEL Classification: M10, M15.

Introduction

This study focuses on investigating the level of knowledge management in the mining industry. A background to the research study will be provided to enable the framing of the research gap and research focus. Subsequently, the research objectives and an overview of the research methodology will be presented. The results of the empirical study will thereafter be reported. Finally the conclusion resulting from the study will be discussed as well as any recommendations that can be made to management and for future studies.

1. Background

According to Davenport and Prusak (2000, p. 5), knowledge is a fluid combination of framed experience, principles, insight from experts and intuition that is grounded for the provision of a framework and environment that enable proper evaluation and incorporation of new experiences and information. Knowledge originates and is applied in the minds of those who know. In organizations, it often becomes embedded in organizational routines, processes, practices and

norms, documents or repositories. In general, there are two types of knowledge: tacit knowledge and explicit knowledge as outlined below.

Tacit knowledge refers to knowledge that exists in a person's mind and can consist of aspects of culture or the way things are done (Nonaka & Krogh, 2009). Tacit knowledge can also be tied to individual perception, rules of thumb and some intuition, skills in body movement, the senses and physical experiences (Von Krogh et al., 2000, p. 6). According to Uriarte (2008, p. 5) tacit knowledge is specific to a certain context and not easy to make formal, recordable or articulate. It consists of intuitions, conjectures and subjective insights.

The degree and facility by which tacit knowledge can be shared depend to a large extent on the willingness and ability of the person having to transfer it to others, because it is highly individualized. The distribution of tacit knowledge is a serious challenge to many organizations. Uriarte (2008, p. 5) recommends that various activities and mechanisms including conversations, workshops and on-the-job training should be used to share and communicate tacit knowledge. Such mechanisms may include the use of information technology tools such as email, groupware, instant messaging and related technologies. In managing tacit knowledge, most organizations struggle to identify the tacit knowledge that is beneficial to the organization. Tacit knowledge becomes extremely beneficial to the organization having it when it is identified because it is a unique asset that is not easy for other organizations to

© Dinko Herman Boikanyo, Ronnie Lotriet, Pieter W Buys, 2016.

Dinko Herman Boikanyo, B.Sc., MBA, Ph.D. Candidate, North-West University in South Africa's Potchefstroom campus, Scientist in a petrochemical, Mining organization in South Africa, South Africa.

Ronnie Lotriet, D.Com., M.Com., Professor, Department of Economic and Management Sciences, Potchefstroom Business School, North-West University, Potchefstroom Campus, South Africa.

Pieter W. Buys, Ph.D. in Accountancy, Ph.D. in Management Accountancy, M.Comm., MBA, CMA, Professor Department of Economic and Management Sciences, North-West University, Potchefstroom Campus, South Africa.

replicate. Its uniqueness and difficulty to duplicate is what makes tacit knowledge a basis of the organization's competitive advantage. Accordingly, it is critical for an organization to find, disseminate and utilize the tacit knowledge of its employees in order to enhance the use of its own intellectual capital. Tacit knowledge is an essential requirement for good decision-making in any organization. It is therefore critical for creating value for the organization (Awad & Ghaziri, 2004).

According to Koenig (2012), explicit knowledge can be referred to as knowledge that is set out in a tangible form. Thus it is knowledge that has been recorded as information in some medium such as a document, image, computer data or photograph. It can be written on a paper, expressed in a form of sentences or shown in drawings and specifications. According to Alwis and Hartmann (2008), tacit knowledge is not entirely isolated from explicit knowledge. The two are mutually complementary. Without tacit knowledge it will be difficult, if not impossible, to understand explicit knowledge. For example, a person without some form of scientific or mathematical knowledge (tacit knowledge) will struggle to comprehend a very complex mathematical formulation or chemical process flow diagram, although it may be easily accessible from the organization's databases or library (explicit knowledge). Tacit knowledge must be converted to explicit knowledge; otherwise it cannot be reflected upon, studied, discussed and shared within the organization as it will stay inside the knower's head and remain hidden and inaccessible (Uriarte, 2008).

Knowledge is one of the most essential assets for organizational success among other assets such as materials, machineries, capital and properties. (Ganesh et al., 2014, p. 3)

Knowledge management (KM) is the name of a concept in which an organization knowingly and systematically collects, organizes, shares and evaluates its knowledge in terms of people skills, resources and documents (Rouse, 2013). Prior (2010) defines knowledge management as a logical and integrated process for finding, gathering, storing, retrieving and converting knowledge and information assets into knowledge that is readily available in order to enhance the performance of the organization. Ahmad (2010) summarized the definition of knowledge management as a set of logical techniques and procedures which are founded on practices and technologies that encourage effective formation, collection, organization, dissemination, utilization and sharing of both valuable explicit and tacit knowledge to enable employees to be more productive in their work and generate value for their organizations.

Thus KM is the process through which organizations generate value from their intellectual and knowledge based assets (Ahmad et al., 2007). Knowledge management involves data mining and some operational method to disseminate information to users. A knowledge management plan consists of a review of strategic goals and a thorough evaluation of the technical tools that are required for addressing the needs of the organization. Knowledge management is made up of the initiatives, processes, strategies and systems which sustain and improve the storage, evaluation, distribution, refinement and creation of knowledge.

According to Liebowitz (2012), knowledge management has three main components: people, process and technology which are explained as follows:

- ◆ People: The people side is about creation and nurturing of an environment and culture of knowledge sharing in the organization.
- ◆ Process: The process side is about management of the KM processes and making knowledge sharing part of the daily work of the employees.
- ◆ Technology is about the formation of an integrated platform for the employees to network and share knowledge.

Skyrme (2011) emphasized that there is a growing interest about the knowledge management due to the following reasons:

- ◆ Competition and globalization – many organizations depend on knowledge for the creation of their strategic advantage.
- ◆ Knowledge can lead to a premium price in the market – applied expertise can improve the value and hence the price of services and products.
- ◆ Downsizing and restructuring – without effective means and procedures to collect knowledge of experienced employees, organizations make mistakes and end up having to pay again for the knowledge that was once readily available.
- ◆ Sharing of best practices – organizations can save costs by capturing the knowledge from their best performers and utilizing it in the same conditions elsewhere.
- ◆ Successful innovation – organizations using knowledge management procedures have realized that they can create new products and services quicker and better through knowledge networking.

According to Deloitte (2015), sharing knowledge leads to competitive advantage and adds a real customer value. Knowledge management prevents employees from continually reinventing the wheel, provides a baseline for measuring progress, decreases the burden on attrition of experts, makes

visual thinking tangible and manages efficiently huge volumes of information to assist employees in serving their clients quicker and better.

The problem statement is discussed below.

2. Problem statement

The mining sector is under a lot of pressure and there have been several reports of certain mines being forced to downsize their labor force as part of cost cutting strategies. The aging workforce together with the high staff turnover caused by either downsizing efforts to cut costs or others leaving to join other companies lead to a loss of knowledge and experience on an ongoing basis in the sector. Reductions in staffing have created a need to replace informal knowledge with formal methods. There is a need for a re-evaluation of the methods used to retain and develop knowledge within the sector.

There is also a scarcity in empirical literature about the use of knowledge management in the sector. This prompted the researcher to investigate the extent of the use of knowledge management and how it contributes to business performance in the sector. This study will not only aim to improve understanding of the concept of knowledge management, but also produce findings of practical relevance and value for the mining and other sectors. Therefore, this research seeks to contribute to both management practitioners and academics alike.

The research objectives of the study are outlined below.

3. Research questions and objectives

The primary aim of this research study is to investigate the extent to which knowledge management is utilized within the mining industry. The secondary objectives are:

- ◆ To determine the relationship between the dimensions of knowledge management and perceived business performance.
- ◆ To compare the findings based on the geographic location of the organizations.

The research methodology used for this study is discussed below.

4. Research methodology

4.1. Research design and sample. A survey design was used. The survey was based on a selection of an unbiased and representative sample of subjects drawn from senior management in the mining organizations in South Africa, Africa and globally. A simple random sampling technique was used to select participants. According to Saunders et al. (2009), simple random sampling involves the

selection of a sample at random from the sampling frame using either a computer or random number tables. A total of 300 mining organizations were randomly selected from a population of 850. A response rate of 64% was achieved.

The survey questions were taken from a questionnaire from a study by Kruger (2010) and also based on the existing literature. The structured questionnaire was sub-divided into sections consisting of the biographic information, items of knowledge management and perceived business performance. A 4-point Likert-type scale was used.

4.2. Statistical analysis. The data gathered from the received questionnaires was captured and analyzed using the statistical software programs, SPSS and STATISTICA, with the help of the Statistical Consulting Services of the North-West University.

Effect sizes and descriptive statistics were utilized to decide on the significance of the findings. The mean and standard deviations are used to describe and compare the results. The mean is used to measure the central tendency of the results. The standard deviation presents the average distance of the individual scores from the mean.

Confirmatory Factor Analysis (CFA) was used to confirm the factor structure of the set of variables. Cronbach Alpha was calculated to check the reliability of the measuring instrument.

Pearson product-moment correlation coefficients were computed to find the relationships between the variables. The statistical significance level was set at a 95% confidence interval ($p \leq 0.05$). The cut-off point of 0.30 is used to determine practical significance of a medium effect.

5. Presentation and discussion of results

The results of the empirical study are reported and discussed below.

Biographical information was reported for number of employees, level of employment, type of metal processed or mined, age of the organization and its geographic location.

A total of 193 questionnaires were received representing a response rate of 64%.

Most of the respondents (66%) were employed in the mines with more than 1000 employees. About 18% of the respondents were from smaller operations with less than 499 employees. The respondents from medium sized mines with 500 to 999 employees were only about 16%.

Most of respondents were managers (57%). Directors formed 34% of the total number of respondents whilst CEOs were only 9%.

Majority of the respondents (51%) were from the mines producing precious metals such as platinum group metals and gold. About 17% were from coal mining organizations and 11% were from the steel industry. About 12% were from the mines producing non-ferrous metals like copper and only 8% were in the industrial metal mines.

About 87% of the respondents were from the mines with more than 20 years in operation. This serves as a confirmation that most of the mines in the world have been in operation for decades. Majority of the respondents were from the South African mining operations (55%), about 23% were from the rest of

Africa while the respondents from other continents such as Australia and the USA were only about 21% of all the respondents.

The results of descriptive statistics are presented in the next section.

5.1. Descriptive statistics. *5.1.1. Knowledge management.* The main objective of this study was to measure the extent of the use of knowledge management by the mining organizations. The questionnaire was designed to help critique the knowledge management process used by the mining organizations. The results of the survey are presented in Table 1.

Table 1. Results of the questionnaire on knowledge management

		Strongly disagree	Slightly disagree	Slightly agree	Strongly agree	Mean	Std deviation
1	Knowledge management assists in creating value out of the intangible assets.	0	9.8	58.0	32.1	3.233	0.609
2	The company values knowledge as a strategic asset, critical for success.	.5	5.2	52.8	41.5	3.354	0.607
3	The culture in the organization is conducive to the sharing of knowledge.	8.3	17.6	56.5	17.6	2.841	0.816
4	The organization benefits from the processes created to contribute knowledge.	4.2	25.5	54.7	15.6	2.825	0.741
5	There is a general culture in the company where people respect knowledge.	3.6	9.4	67.2	19.8	3.042	0.651
6	Employees are responsible for the transfer of knowledge in their areas of responsibility.	3.1	13.0	53.4	30.6	3.106	0.743
7	Knowledge is accessed by employees by means of a central intelligence repository.	22.5	20.9	37.2	19.4	2.534	1.039
8	The organization has the technical infrastructure to enable knowledge sharing.	13.0	19.2	48.7	19.2	2.725	0.91
9	There is transfer of knowledge about best practices among employees in order to improve operational efficiency.	16.6	18.1	36.8	28.5	2.778	1.048
10	There is a document management system in place.	14.1	15.1	54.2	16.7	2.751	0.897
11	The organization stores intellectual capital.	4.7	13.5	67.4	14.5	2.937	0.649

Source: Compiled by authors from survey results.

The mean score for question 1 is 3.23 with low standard deviation of 0.609. About 90% of the participants responded positively and agreed that knowledge management assists in creating value out of the intangible assets in their own organizations. The mean score for question 2 was also high (3.35) with a low standard deviation because about 94% of the respondents agreed that their organizations value knowledge as a strategic asset which is critical for success.

About 26% of the participants responded negatively to question 3 indicating that the culture in their organizations is not conducive to the sharing of knowledge. Almost 30% of the respondents do not believe that their organizations are currently benefitting from the processes created to contribute knowledge. About 32% of the participants indicated

that their organizations do not have the technical infrastructure to enable knowledge sharing and 35% believe that there is no transfer of knowledge within their organizations about the best practices among the employees in order to improve operational efficiencies. About 29% also indicated that their organizations do not have document management systems in place. Question 7 had the lowest mean score because 47% of the participants responded negatively to this question. This means that almost half of the respondents do not agree that knowledge is accessed by means of a central intelligence repository in their organizations.

The perceived business performance of the organizations is discussed below.

5.1.2. Perceived business performance. The results for the overall business performance are shown in Table 2.

Table 2. Mean scores in ranking order for perceived business performance

		Strongly disagree	Slightly disagree	Slightly agree	Strongly agree	Mean	Standard deviation
1	The overall performance of the organization meets expectations.	23.8	20.2	20.7	35.2	2.67	1.19
2	Top management is satisfied with the overall performance.	24.4	26.4	22.8	26.4	2.51	1.13
3	Sales are relatively good.	20.2	14.0	37.3	28.5	2.74	1.08
4	The organization continues to be profitable.	14.0	25.4	28.5	32.1	2.79	1.05
5	Cash flow is stable.	14.0	16.1	58.0	11.9	2.68	0.86
6	The organization is satisfied with its market share.	17.6	25.4	25.9	31.1	2.70	1.09
7	The organization is satisfied with the productivity of the current operation(s).	24.4	35.2	37.3	3.1	2.19	0.84

Source: Compiled by authors from survey results.

Majority of the organizations (60%) were not satisfied with the productivity of their current operations. There was also a large number (51%) of respondents who indicated that their top management was not satisfied with the overall performance of the organizations. The overall performance of a significant number (44%) of the mines was not meeting expectations. About 39% indicated that they were not profitable while about 43% were not satisfied with their current market share. A significant number (30%) of the mines indicated that their cash flows were not stable. The other objective was to confirm the factor

reliability of the dimensions which were used. The results are shown in the following section.

5.2. Factor analysis. An instrument has a high reliability if it can be trusted to give a consistent and accurate measurement of an unchanging value. Reliability was computed and calculated by means of Cronbach alpha. According to Sekaran and Bougie (2010), Cronbach alpha coefficient should be greater than 0.70 for the data to be considered as internally consistent and reliable. Factor reliability of the identified dimensions is presented in Table 3.

All the factors display satisfactory levels of reliability with alpha coefficients ranging from 0.870 to 0.95.

Table 3. Results of factor reliability

Factor	Cronbach alpha	Cronbach alpha based on standardized items	N of items	Mean	Minimum	Maximum	Range	Variance
Knowledge management	0.876	0.873	11	2.921	2.534	3.354	0.820	0.059
Business performance	0.946	0.946	7	2.613	2.192	2.788	0.596	0.042

Source: Compiled by authors from survey results.

The other main objective was to determine if there are any positive relationships between the use of knowledge management and the perceived business performance of those organizations. The results of those correlations are shown and discussed below.

5.3. Correlations. The results of the product-moment correlation coefficients between the constructs are reported in Table 4.

Table 4. Correlation coefficients between knowledge management and perceived business performance dimensions

	Business performance	Knowledge management
Business performance	1.000	.705**
Knowledge management	.705**	1.000

** Correlation is significant at the 0.01 level (2-tailed).

Source: Compiled by authors from survey results.

The table shows that knowledge management dimension is positively correlated to business performance (practically significant, large effect).

The other objective of this study was to compare the findings based on geographic location of the organizations. This was achieved by using the ANOVA tools to establish if there were any significant differences. The results are discussed below.

5.4. Differences according to geographic location. Table 5 shows the results of the mean values calculated for the dimensions as a function of the geographic location of the organization. The results of the ANOVA calculation are also shown.

For all the dimensions, the *p*-value is less than 0.05 indicating that the participants in different geographic locations answered the questions in a significantly different manner statistically. The results for the effect sizes indicate that for all the dimensions, the *d*-value was 0.8 for Africa when compared to other continents. This indicates a large practically visible difference. The mean values for Africa were the lowest indicating that the mining organizations in Africa rank the lowest in terms of applications of knowledge management principles.

Table 5. Descriptive statistics and ANOVA results for the geographic location

		N	Mean	Std deviation	Effect size		ANOVA	
					SA	Africa	F	Sig.
Knowledge management	SA	107	2.899	0.586			9.27	0.00
	Africa	45	2.747	0.485	0.26			
	Other	37	3.128	0.309	0.39	0.79		
	Total	189	2.907	0.532				

Source: Compiled by authors from survey results.

6. Conclusion

Conclusion regarding the specific theoretical objectives and the results of the empirical study are made.

6.1. Conclusions regarding the specific theoretical objectives. The mining organizations can also benefit from implementing knowledge management systems like other industries. The effective management of knowledge in these organizations has the capability to positively impact the manner in which they do business from the little details of daily operations to the major strategic decision-making processes. An important goal of knowledge management is the sharing of the best practices. By utilizing knowledge management, the organizations can provide their employees with the ability to find and use procedures and methods which were formed or used by others in the past to solve similar problems and to learn from previous experiences, while maintaining the newly formed experiences to be utilized in the future. Thus by re-using and sharing previous knowledge and experiences, employees can solve their problems without spending more time, resources and efforts on reinventing solutions that have previously been invented elsewhere in the organization.

Knowledge management is essential for the successful management of mining operations and a complement to the other business activities of these organizations. Knowledge is indeed one of the most vital assets for organizational success. With the successful collection, distribution and creation of valuable knowledge, the mining organizations can enhance the process of organizational learning to improve performance and create more possibilities to gain competitive advantages.

6.2. Conclusions regarding the specific empirical objectives. Results of the factor analysis showed that all the factors displayed satisfactory levels of reliability with alpha coefficients ranging from 0.87 to 0.95. Most of the respondents agreed that their organizations value knowledge as a strategic asset which is critical for success.

A significant number of the respondents do not agree that their organizations are currently benefitting from the processes created to contribute

knowledge. Some of the participants indicated that their organizations do not have the technical infrastructure to enable knowledge sharing. About 35% believe that there is no transfer of knowledge within their organizations about the best practices among the employees in order to improve operational efficiencies.

The results also indicated that majority (60%) of the organizations were not satisfied with the productivity of their current operations. A significant number (30%) of the mines indicated that their cash flows were not stable at all.

The results also confirmed that a statistically and practically significant positive relationship with a large effect exists between the construct of knowledge management and business performance. The data indicate that mines in other continents use knowledge management systems more than those in SA and the rest of Africa. Lowest means were observed for mines in other African countries.

Recommendations

Based on the review of literature and the empirical data generated in this study, the researcher makes the following recommendations to the managers of the mining organizations. The recommendations are generally applicable to any industry.

- ◆ Organizations should create and promote a knowledge sharing culture.
- ◆ Integration of knowledge management processes such as acquisition, creation, sharing, utilization and transfer into the essential activities of the organization should be carried out by the managers.
- ◆ Two generic knowledge management strategies are proposed. The first one is personalization strategy which is about connecting people who possess knowledge to those who need it. The second one is codification with its main emphasis being on documenting knowledge, storing it in databases and then distributing it to those who need it. Depending on the available resources, any one of these strategies can be used for knowledge management.
- ◆ Organizations should perform a knowledge audit which normally involves identification of critical knowledge assets and knowledge competencies as

well as identification of experts in various knowledge domains within the organization.

- ◆ A design of knowledge architecture is recommended for managing explicit knowledge mainly in the form of documents and reports in file cabinets.
- ◆ Organization could also invest in a proper knowledge infrastructure which comprises facilities such as talk rooms and libraries.

Participants in different geographic areas responded differently to the questions about the use of knowledge management and business performance. Possible reasons for this can be determined by further research. A significant number of participants indicated that the culture in their organizations is not conducive to the sharing of knowledge. A possible framework to create such a culture can also be established by further research.

References

1. Ahmad, H.S. (2010). Development of KM model for knowledge management implementation and application in construction projects. Doctoral Thesis. University of Birmingham. Available at: http://etheses.bham.ac.uk/1307/1/Ahmad11PhD_A1a.pdf. Accessed 15/11/2015.
2. Ahmad, H.S., An, M. & Gaterell, M. (2007). Development of KM model to simplify knowledge management implementation in construction projects. Proceedings of the 23rd Annual ARCOM Conference, Association of Researchers in Construction Management. Belfast, UK, pp. 515-525.
3. Alwis, R.S. & Hartmann, E. (2008). The use of tacit knowledge within innovative companies: knowledge management in innovative enterprises, *Journal of Knowledge Management*, 12 (1), pp. 133-147.
4. Awad, E.M. and Ghaziri, H.M. (2004). Knowledge Management, Printice Hall.
5. Davenport, T. & Prusak, L. (2000). *Working knowledge: how organizations manage what they know*. Boston: Harvard Business School Press.
6. Deloitte. (2015). Benefits of knowledge management. Available at: <http://www2.deloitte.com/lu/en/pages/strategy/articles/benefits-knowledge-management.html>. Accessed: 04/11/2015.
7. Frost, A. (2011). Knowledge Management Definition. Available at: <http://www.knowledge-management-tools.net/knowledge-management-definition.html>. Accessed 01/09/2014.
8. Ganesh, K., Mohapatra, S. & Nagarajan, S. (2014). *Design and development of knowledge management for manufacturing*. Switzerland: Springer International Publishing.
9. Koenig, E.M. (2012). What is KM? Knowledge management explained. Available at: <http://www.kmworld.com/Articles/Editorial/What-Is-.../What-is-KM-Knowledge-Management-Explained-82405.aspx>. Accessed 12/06/2015.
10. Kruger, J. (2010). A study of strategic intelligence as a strategic management tool in the long-term insurance industry in South Africa. University of South Africa. Masters Thesis.
11. Liebowitz, J. (2012). *Knowledge Management Handbook: Collaboration and social networking*. 2nd ed. CRC Press.
12. Nonaka, I. & Krogh, G.V. (2009). Tacit knowledge and knowledge conversion: controversy and advancement in organizational knowledge creation theory, *Organization Science*, 20 (3), pp. 635-652.
13. Prior, V. (2010). Glossary of terms used in competitive intelligence and knowledge management. Available at: http://www.comintelli.com/Documents/Glossary_CI_and_KM. Accessed 25/10/2015.
14. Rouse, M. (2013). Knowledge Management (KM). 2014. Available at: <http://searchdomino.techtarget.com/definition/knowledge-management>. Accessed 25/10/2015.
15. Saunders, M., Lewis, P. & Thornhill, A. (2009). *Research methods for business students*. 5th ed. Essex England: Prentice Hall.
16. Skyrme, D. (2011). Knowledge management. Available at: <http://www.skyrme.com/kmv5.htm>. Accessed 15/10/2015.
17. Uriarte, F.A. (2008). *Introduction to knowledge management: A brief introduction to the basic elements of knowledge management for non-practitioners interested in understanding the subject*. Jakarta, Indonesia: ASEAN Foundation.
18. Von Krogh, G., Ichijo, K. & Nonaka. (2000). *Enabling knowledge creation, how to unlock the mystery of tacit knowledge and release the Power of Innovation*. New York: Oxford University Press.