

# Knowledge Management Maturity Assessment in the Roads Engineering Environment

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Focus Area 5: Meeting the needs of Society

Topic 3: Meeting the needs for Capacity and Skills development in the bituminous industry

## Abstract

This research is about investigating Knowledge Management (KM) processes in the consulting engineering environment, for roads related consultants in particular.

Knowledge Management is arguably one of the subjects most discussed in today's world. It is important to most consulting practices because it is viewed as an activity that can minimize costs of employing specialists and/or professionals, with the potential for increasing profit margins for organisations.

Knowledge flows comprise a set of processes, events and activities through which data, information, knowledge and meta-knowledge are transformed from one state to another. This research highlights the fact that knowledge management is related to knowledge resources and knowledge development in several ways, firstly knowledge management implies identifying types of knowledge in a community and the scales on which the types are or will be measured, and secondly, knowledge management implies identifying the knowledge creation processes.

The study has shown that roads consultants experienced difficulties in implementing knowledge management practices, because of lack of time or resources to concretely share knowledge on a day-to-day basis, because staff does not make documents available to others spontaneously and there are difficulties in capturing employee's undocumented knowledge (know-how).

Regarding the **culture** of roads consultants, the research showed that:

- Staff considers that sharing knowledge will be good for their career
- Staff do not spontaneously organize knowledge events such as meetings with staff from other divisions/departments, and
- Staff make documents available to others more spontaneously.

*Keywords:* Knowledge Management, Information Management, Knowledge Retention, Maturity Model, Information and Communication Technology (ICT)

## 1 Introduction

According to the knowledge praxis [Barclay and Murray, 1997], systematic approaches to Knowledge Management retain the traditional faith in rational analysis of the knowledge problem. The problem can be solved, but new thinking of many kinds is required. The primary assumptions are:

- It is sustainable results that matter, not the processes or technology or the individual's definition of "knowledge".
- Knowledge management has an important management component, but it is not an activity or discipline that belongs exclusively to managers.
- Resources cannot be managed unless modelled, and many aspects of the organization's knowledge **can** be modelled as explicit resources.
- Solutions can be found in a variety of disciplines and technologies, and traditional methods of analysis **can** be used to re-examine the nature of knowledge work and to solve the knowledge problem.
- Cultural issues are paramount and must be evaluated systematically. Employees may or may not have to be "changed," but policies and work practices must certainly be changed, and technology can be applied successfully to business knowledge problems themselves.

In the roads consulting engineering environment, the implementation of the Knowledge Management principles appears not to be carried out in an adequately structured manner. The maturity levels of the knowledge management implementation are unknown since there are no mechanisms within the consulting engineering industry for measuring maturity.

The objective of the study upon which this paper is founded, is, through the use of structured questionnaires, to determine the knowledge management maturity in the consulting engineering environment, focussing primarily on consulting firms that are involved in the roads sector. The determination of the maturity level for the consulting engineering environment is necessary to establish the baseline upon which future measurements may be based. The knowledge management maturity model will provide some "insight" to the industry and at the same time point to the challenges of what has to be done for solid improvement. These strategic insights may prove beneficial as the roads industry matures in the marketplace. They will help to keep pace with the capacity development that becomes necessary when experts retire.

## 2 Theoretical Background

### 2.1 What is knowledge management?

The Knowledge Praxis [Barclay and Murray, 1997], defines knowledge management as a business activity with two primary aspects:

- Treating the knowledge component of business activities as an explicit concern of business reflected in strategy, policy, and practice at all levels of the organization.
- Making a direct connection between an organization's intellectual assets — both explicit [recorded] and tacit [personal know-how] — and positive business results.

Smits and de Moor (2003) state that knowledge management is related to knowledge resources and knowledge development in several ways. They believe that firstly knowledge management implies identifying types of knowledge in a community and the scales on which the types are or will be measured, and secondly, knowledge management implies identifying

the knowledge creation processes (in a community and the existing learning and disabilities, according to Nonaka *et al* (1995) and Senge (1990)).

Addicott, McGivern and Ferlie (2006) state that many large companies and non-profit organisations have resources dedicated to internal knowledge management efforts, often as a part of their 'business strategy', 'information technology', or 'human resource management' departments. They also believe that several consulting companies that provide strategy and advice regarding internal knowledge management to these organisations are in existence.

Authors such as Rosenberg (2001), Groff and Jones (2003), and Newman (1999) have shown that knowledge management (KM) is the combination of organizational culture, strategic goals, individual needs, and the expertise of its people to create an atmosphere of learning and growth. Knowledge management must therefore be an important cog of commercial doctrine for knowledge sharing to succeed.

## 2.2 Knowledge Management Models

Brian and Kurt (1999) are of the opinion that knowledge flows comprise the set of processes, events and activities through which data, information, knowledge and meta-knowledge are transformed from one state to another. They postulated a model that organizes knowledge flows into four primary activity areas: knowledge creation, retention, transfer and utilization (Quote):

**Knowledge Creation** - this comprises activities associated with the entry of new knowledge into the system, and includes knowledge development, discovery and capture.

**Knowledge Retention** - this includes all activities that preserve knowledge and allow it to remain in the system once introduced. It also includes those activities that maintain the viability of knowledge within the system.

**Knowledge Transfer** - This refers to activities associated with the flow of knowledge from one party to another. This includes communication, translation, conversion, filtering and rendering.

**Knowledge Utilization** - This includes the activities and events connected with the application of knowledge to business processes.”

This General Knowledge Model sequences the activity areas in a deterministic fashion. According to Brian and Kurt (1999) the model is valuable because it relates the individual, highly dynamic behaviours and processes to general activity areas and, by association, to each other.

Smith (2003) outlined an approach and a model to analyse knowledge management, distinguishing between (i) types of knowledge, (ii) processes of knowledge development and social learning, and (iii) indicators and metrics for (i) and (ii). Three levels of knowledge management (KM) were distinguished: operational KM, maintenance KM, and long-term KM [De Moor and Smits, 2002].

Kasper and Haltmeyer (2005) brought about the idea of context factors with regard to knowledge sharing. They believe that the process of knowledge management and organizational learning cannot be examined separated from its context. Since the context factors have a strong impact on the process of knowledge management, the process and context of knowledge management are highly intertwined. The context factors identified included culture; language; workforce diversity; global mind set; organisational culture and network structures.

## **2.3 Management and Measurement of Knowledge Management**

Smits and de Moor (2003) state that measurement of knowledge management can have many objectives, including providing feedback, making a business case, learning, and developing benchmarks for future comparisons and others. Measuring the value of knowledge (and of knowledge management) remains a challenge in knowledge management, with the growing realization that financial measures "look backwards and at physical assets only", organizations need to get a grip on measuring what is perhaps their most valuable asset - knowledge.

The benefits cited by Smits and de Moor (2003) for knowledge management measuring include:

- True reflection of the actual worth of the company
- Gaining insights into the drivers of sustainable performance
- Effective governance of social and environmental
- Protection and growth of assets that reflect value
- Supporting a corporate goal of enhancing shareholder value
- Provision of more useful information to existing and potential investors.

## **3 Proposed models**

### **3.1 Knowledge Management Maturity Models**

There is no such thing as a perfect management system or style for any business, organization, or institution. What most companies do is try to find something that works within the framework of their business to manage employees and staff personnel. Management styles come and go and trends work and fail. That is why it is impossible to say that one style of management is the best and can work under any conditions. The challenges of finding the right system at the right time are immense for companies and their managers. Any policy and selective strategies will have to be tested, evaluated, and assessed to measure the results. This, by itself, becomes a major management issue.

A number of knowledge management maturity models have evolved over a period of time. A knowledge maturity model defines stages of maturity that an organization can expect to pass through in its road to improve its overall knowledge-centric practices and processes and ultimately business performance. Thus the maturity model describes identifiable stages on the way to KM maturity and widens the perspective by bringing good practice KM activities and processes into consideration.

#### **3.1.1 The Knowledge Compass Inc [TKCI] KM Maturity Model (KMmm®)**

The Knowledge Compass Inc [TKCI] (2006) created a model methodology and tool that assesses the critical areas of knowledge use within the enterprise. The knowledge management assessment areas for the KMmm® are: Strategic, People, Process, and Technology. The successful use of the TKCI KMmm® within an assessment of an organization's knowledge management infrastructure should provide:

- Current level of KM maturity
- KM Maturity Model
- Guidance on how to improve environment to higher maturity levels
- Baseline for future knowledge maturity measurements

### **3.1.2 The Strategic Knowledge Management Maturity Model (Kruger and Snyman)**

Kruger and Snyman (2007) state that maturity modelling is an evolutionary process describing the development of an entity over time, progressing through different levels towards some form of idealistic state. Kruger and Snyman (2007) further state that maturity not only implies a potential for growth in capability, but also focuses on richness and consistency with regard to execution. Kruger and Snyman (2007) proposed a Knowledge Management Maturity Model based on building checks and balances into the evolutionary path of both ICT and knowledge management, consisting of six phases.

**Phase 1:** Information and Communications Technology (ICT) as an enabler of knowledge management, where knowledge still resides in where the knowledge originates i.e. in the person that knows.

**Phase 2:** Deciding on knowledge management principles. During this stage, ICT systems within the organization evolve to a level where the organization knows what constitutes data and information systems.

**Phase 3:** The ability to formulate an organization-wide knowledge policy. The primary goal of this phase is the formulation of an organization-wide knowledge policy on how the organization is going to manage, secure and protect knowledge as a strategic resource (both tacit and explicit); as well as guidelines on how the organization's knowledge repository should be formulated.

**Phase 4:** Building knowledge strategy/strategies. Efficient and effective ICT architectures and knowledge infrastructures are in place at this level, and managers become more than just aware of the power vested in knowledge but are also consciously encouraging endeavours in knowledge management.

**Phase 5:** Formulation of knowledge management strategies. At this level, organizations are capable of formulating efficient and effective plans to change the organization's knowledge structure and of supporting ICT structure from the 'as is' to the required 'should be' structure.

**Phase 6:** Ubiquitous knowledge. During this phase, knowledge management seamlessly integrates with the enterprise eco-system consisting of customers, business partners, (shareholders, alliances, etc.). The organization's ICT architecture must now be capable not only of sharing data and information, but also knowledge and expertise with all stakeholders in the organization's extended value chain.

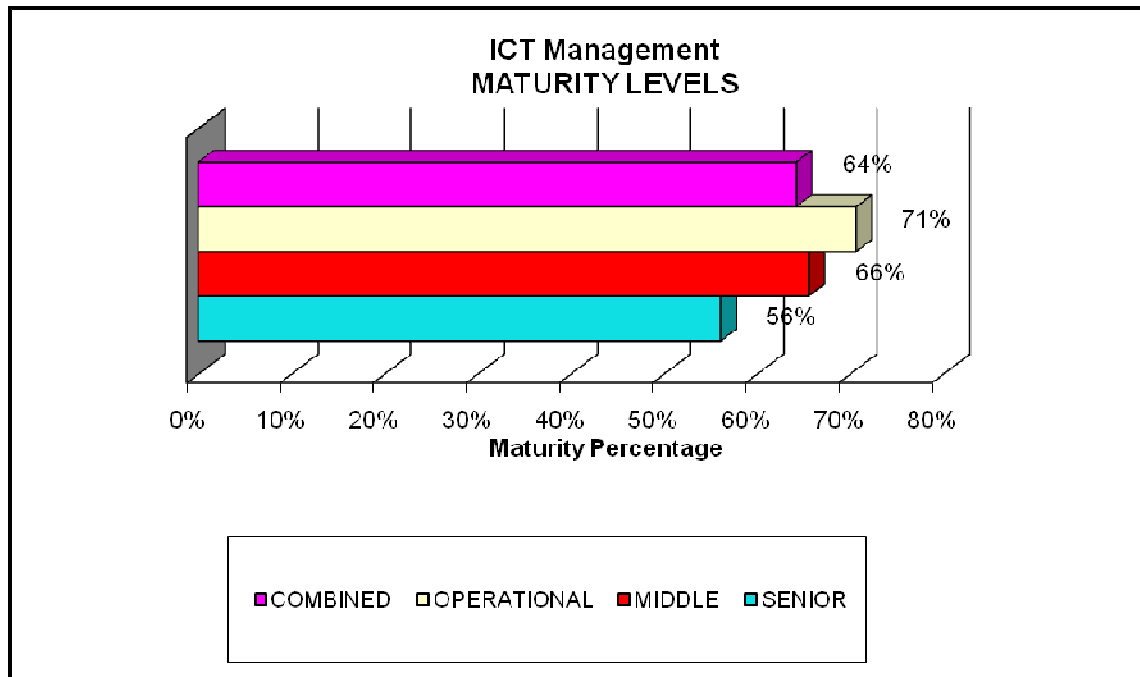
## **4 Results of the analysis**

The questionnaire designed by Kruger and Snyman (2007) was utilised as it was deemed to be the best tool for this research.

### **4.1 ICT Management**

The answers from the operational and middle management personnel were very similar yet distinctively different from the answers provided by senior management. Senior management has a somewhat more critical view of how they perceive the company's capability on ICT – this could also be based on the actual knowledge that the senior management have on the policies of the company. The results indicate that over 80% of the respondents agree that roads consultants are capable of evaluating, designing and planning an ICT system and have an effective ICT infrastructure.

An overwhelming majority 82% of the combined respondents believe that roads consultants regard ICT and ICT management as an enabler of knowledge management. The operational personnel closely agree with the senior management while there is a significant percentage of middle management (29%) that believes ICT to be knowledge management.



**Figure 4-1: ICT Management Maturity Levels**

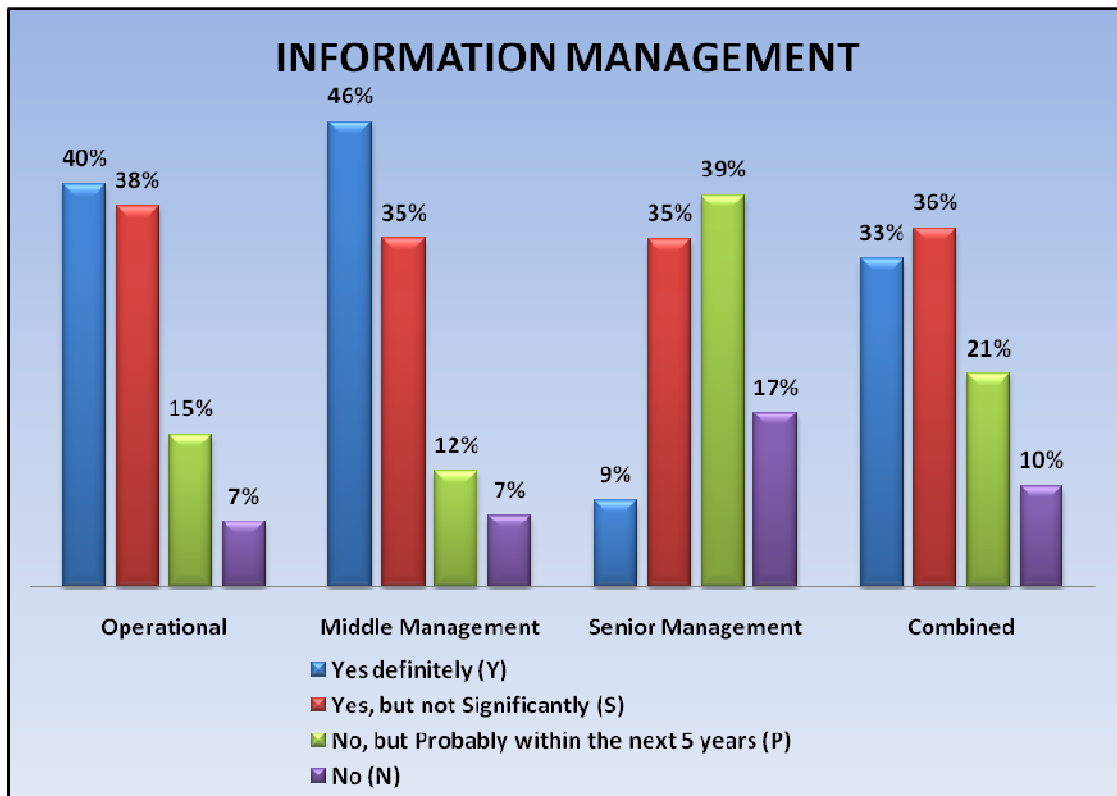
This section tests whether the company (roads consultants) is able to deal with important criteria such as ICT Management. The combined maturity score attained for this section is 64%. The researcher believes and agrees with operational management that the ICT Management maturity level is high and is in the region of 70% because the operational management personnel are the people who deal with ICT issues more frequently.

## 4.2 Information Management

On average, more than 80% of the respondents believe the roads consulting engineering environment has a clearly defined information management (IM) policy, has a clearly defined information management (IM) strategy, understands which information resources are crucial to the business, and that key information is easily available. 15% of the middle management (0% for Senior) however believe that roads consulting companies do not comply with the above statements.

25% of the respondents do not agree that the industry is proficient in the information management activities of: Identification of information needs; Acquisition of information; Information storage; Information distribution; Information retrieval; Information disposal; Protection of information; Determination of the value and cost of information

Senior Management (11%) differs significantly with operational (43%) and middle management (46%) regarding how they perceive the tools and services to have been definitely institutionalised. In total, 90% of the respondents believe the tools and services (Inventory of information entities; Information management systems; Databases; Information service / Library) will be institutionalised within the next five years.



**Figure 4-2: Institutionalisation of Information management Tools and Services**

63% [46% + 17%] of senior management compared to 19% [12% + 7%] of middle management believe that the *tools and services* have not been institutionalised (No answer). This gap in perception of 44% (63% - 19% = 44%) between senior management and middle management, is worrying because these two classes are supposed to be working closely with each other. This could suggest a gap in communication between senior management and, middle and operational management.

Operational and middle management broadly agree that roads consultants regard information management as a pre-requisite for knowledge management (76% and 71% respectively). This is in sharp contrast to the view of senior management (83%) who think the organisation regards information management as knowledge management.

Apart from testing the extent of the proficiency in information management in the organisation, this section also tests whether information management tools and services are successfully institutionalised. The average maturity level for this section is 58%.

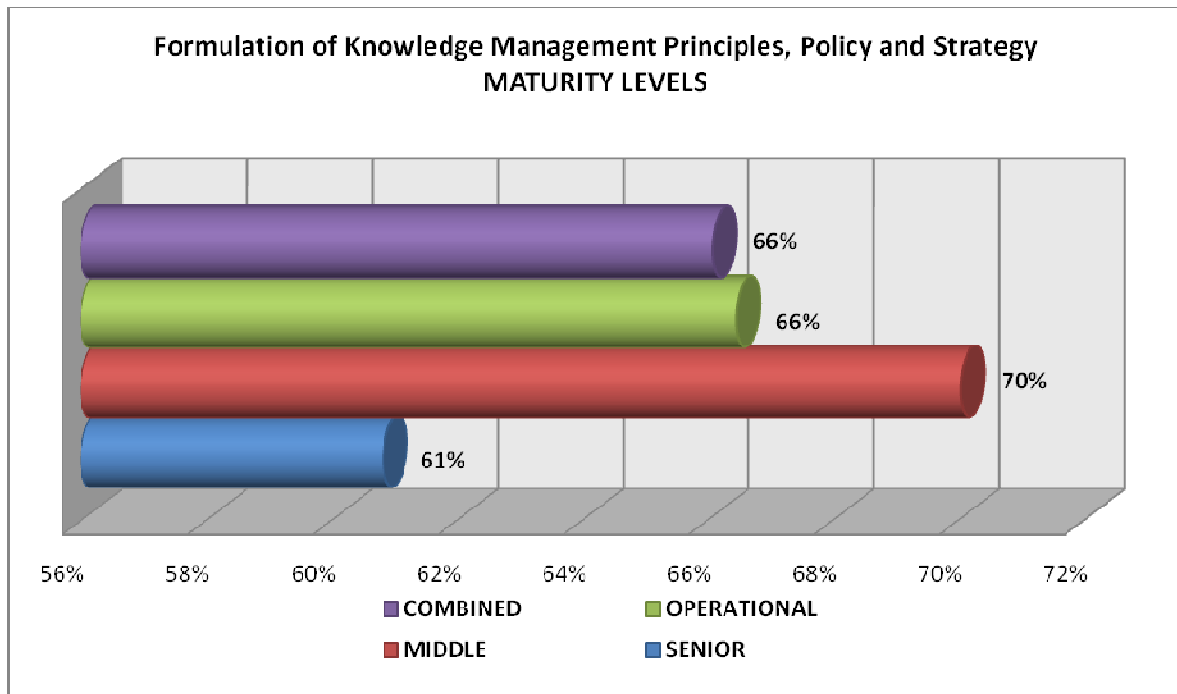
#### **4.3 Formulation of Knowledge Management Principles, Policy and Strategy**

On average, 75% of the respondents agree that the consulting environment is aware of the power vested in knowledge, that good knowledge management is one of the top five (5) internal priorities, and, that the management of knowledge is supplying a direct input to the strategic management process. There is however a major variation with respect to senior management where only 20% definitely agree and 50% rate the statements to be true but not significantly. The percentages (for senior management) are a direct opposite of middle management i.e. 51% definitely agree and only 20% rate the statements to be true but not significantly.

On the other hand nearly 50% of the respondents agree that the industry complies but not significantly, that

- (a) The consulting industry has a clearly defined knowledge management (KM) policy
- (b) The consulting industry has a clearly defined knowledge management (KM) strategy
- (c) The KM strategy has been communicated widely to staff

All the respondents believe that the consulting industry already has a knowledge management strategy and that this strategy has key elements that include information management (94%) and information technology (6%). The respondents do not think that human resources management and organizational aspects are included.



**Figure 4-3: Formulation of Knowledge Management Principles, Policy and Strategy Maturity Level**

This section addresses questions surrounding awareness of the power vested in knowledge and whether knowledge is seen as a strategic corporate resource. The maturity level attained for this section is 67%. The maturity levels attained by the different management levels are 66% (operational), 61% (senior) and 70% (middle).

#### 4.4 Implementation of Knowledge Management

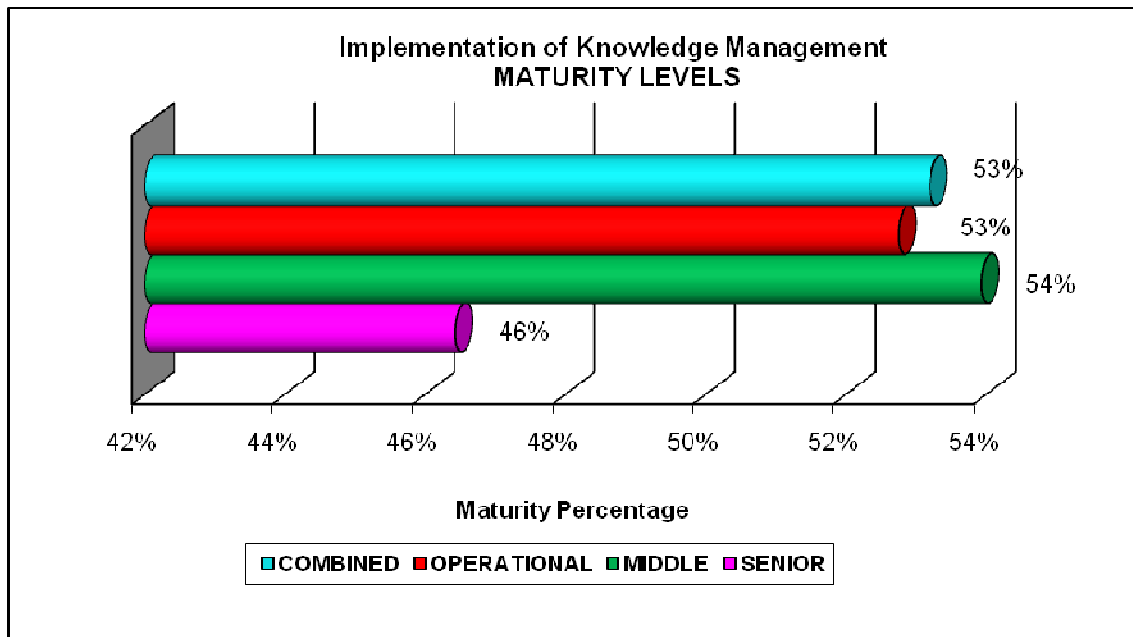
The research has shown that 60% of the respondents deem the overall responsibility for knowledge management within the industry to be that of a special knowledge management unit, 21% consider it to be the responsibility of the information technology team while 16% think that top managers are responsible. Only a few individuals within middle management (7%) believe that the human resources management team have some responsibility.

The industry is satisfied that staff members spend an increasing amount of time on peer reviews (53%) and informational meetings (28%). The research has shown that respondents believe that there are no guideline documents and that good work practices have been

outlined and updated on a regular basis, in training manuals (74%) and best practice documents (26%).

According to the research, the most common methods which are conducted to assess the progress made in *implementing* knowledge management practices are the use of score cards (73%) and the use of indicators (27%). Oral feedback and inter-organisational comparisons are not used.

The respondents consider that the consulting industry has experienced difficulties in implementing knowledge management practices because the organization has put a strong focus on information and communication technology, rather than on people or organizational matters (27%) and due to lack of time or resources to concretely share knowledge on a day-to-day basis (73%).



**Figure 4-4: Implementation of Knowledge Management Maturity Level**

According to Kruger (2009), this section tests the extent the organisation has set up endeavours or institutionalised initiatives to manage knowledge successfully. The maturity level attained for this section is 53%. The maturity levels attained by the different management levels are 53% (operational), 46% (senior) and 53% (middle).

#### 4.5 Ubiquitous knowledge

There are significant differences of opinions between the operational/middle management and senior management regarding the areas where they think the organisation is relying on some outside knowledge. On the average, the respondents are of the opinion that the organisations (roads consulting firms) rely equally on outside knowledge from peer organisations and intra-sectors, and in nearly twice as much from local governments. The maturity level attained for this section is 36%.

#### 4.6 Assessment of Knowledge Management Growth

The research has shown that 97% of the respondents believe that there was a significant growth in knowledge management within the last 5 years and the remaining 3% (mainly from middle management) believe the growth will happen within the next 5 years.

#### 4.7 Summary of Maturity

As mentioned previously, Kruger and Snyman (2007) developed a four point Likert scale to express the degree of agreement with the questions put forward which calculated the overall maturity score based on multiple sections and expressed as values or percentages<sup>1</sup>. The table below indicates the *Maturity for all Management Levels per Maturity Section*.

In summary:

- **ICT Management** – operational management has the highest maturity level of 71% [Senior – 58%, Middle – 66%].
- **Information Management** - operational management has the highest maturity level of 66% [Senior – 45%, Middle – 61%].
- **KM Issues** (Principles, Policy, Strategy) - middle management has the highest maturity level of 70% [Senior – 61%, Operational – 66%].
- **Implementation of KM** - middle management has the highest maturity level of 54% [Senior – 46%, Operational – 53%].
- **Ubiquitous Knowledge** - operational and middle management has the highest maturity level of 34% [Senior – 29%].
- **Assessment of KM Growth** - middle management has the highest maturity level of 73% [Senior – 64%, Operational – 61%].

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<sup>1</sup> To analyse the data as percentages, the number of points for each section was summed, and divided by the maximum points possible for that section.

### SUMMARY OF MATURITY LEVELS

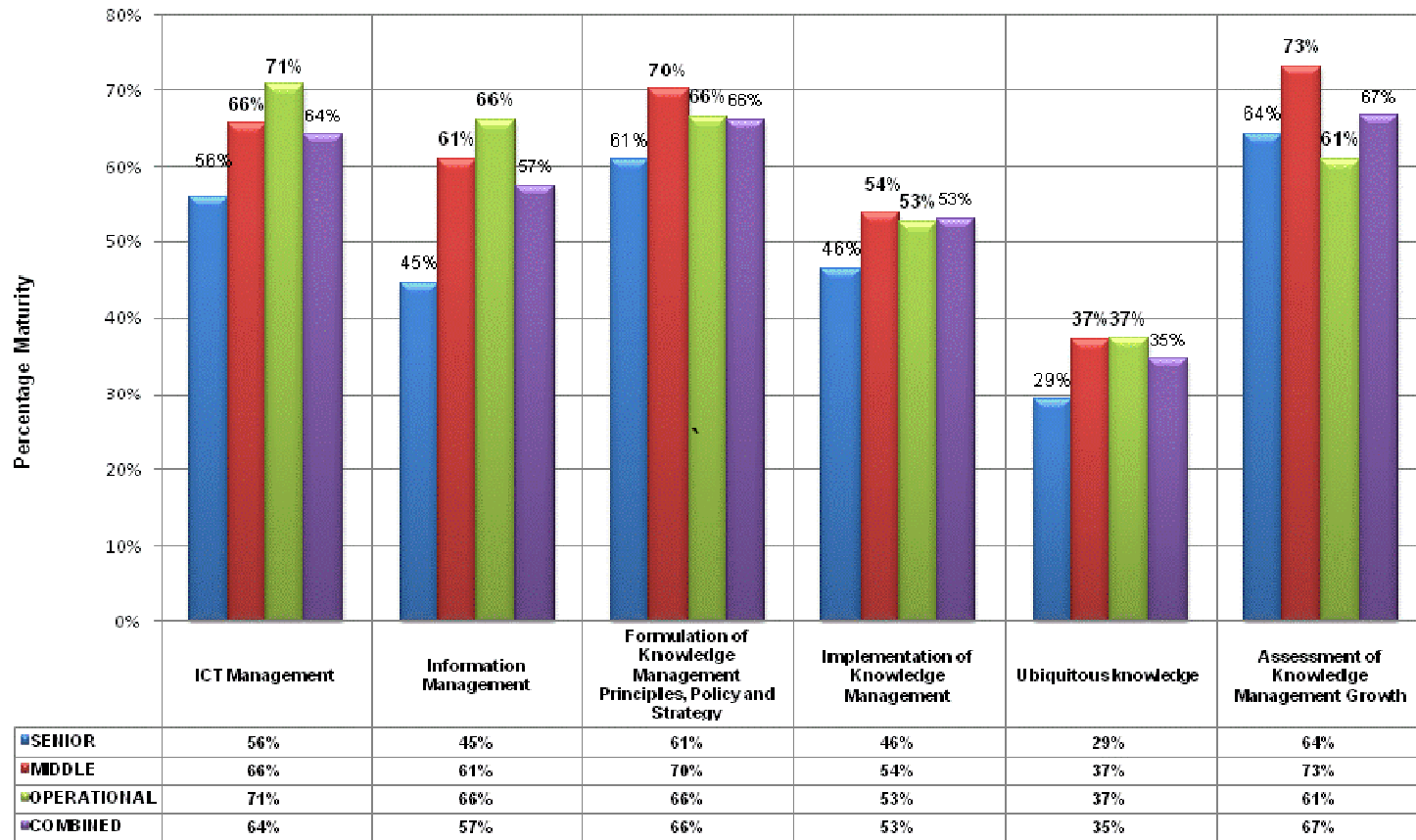


Figure 4-5: Maturity for all Management Levels per Maturity Section

The table below shows the total points calculated for each knowledge management section, and for each level of management. The summation of the points for all the sections gives the total maturity points. The total maturity points were converted to a percentage by dividing by the total points possible i.e. by 358 as stated earlier.

**Table 4-1: Knowledge Management Maturity - Roads Consulting Engineering Environment**

SECTION	DESCRIPTION	SENIOR	MIDDLE	OPERATIONAL	COMBINED
1	ICT Management	11.22	13.11	14.13	12.84
2	Information Management	33.86	46.36	50.26	43.69
3	Formulation of Knowledge Management Principles, Policy and Strategy	53.53	61.64	58.49	58.16
4	Implementation of Knowledge Management	43.65	50.70	49.59	50.01
5	Ubiquitous knowledge	22.22	28.21	28.35	26.39
6	Assessment of Knowledge Management Growth	2.57	2.93	2.43	2.66
	Total	<b>167.04</b>	<b>202.95</b>	<b>203.25</b>	<b>193.75</b>
	<b>TOTAL MATURITY (total / 358<sup>2</sup>) [%]</b>	<b>46.66%</b>	<b>56.69%</b>	<b>56.77%</b>	<b>54.12%</b>

**Table 4-2: Knowledge Management Maturity as a percentage - Roads Engineering Environment**

SECTION	DESCRIPTION	MATURITY ACCORDING TO MANAGEMENT LEVELS				
		SENIOR	MIDDLE	OPERATION.	COMBINED	Max Points
1	ICT Management	56%	66%	71%	64.19%	20
2	Information Management	45%	61%	66%	57.49%	76
3	Formulation of Knowledge Management Principles, Policy and Strategy	61%	70%	66%	66.09%	88
4	Implementation of Knowledge Management	46%	54%	53%	53.20%	94
5	Ubiquitous knowledge	29%	37%	37%	34.73%	76
6	Assessment of Knowledge Management Growth	64%	73%	61%	66.55%	4
	<b>Total</b>					<b>358</b>

## 5 Conclusions and recommendations

It was observed that in some respects, answers from middle management differ significantly with answers from senior management. This is a worrying phenomenon given that middle management is expected to carry out policies and strategies formulated by senior management.

### Section 1: ICT Management

Section 1: ICT management, according to Kruger and Johnson (2009) is meant to assess the organisation's ability to deal with tangible criteria such as ICT management. With a combined or average maturity level of 65% (56%-senior management; 66%-middle management and 71%-operational management), the research has indicated that the industry is lagging behind in ICT management when compared to similar organisations in the

<sup>2</sup> 358 is the total number of points possible based on a Likert scale

industry (73.60% stated in Kruger (2008), Kruger & Johnson (2009)). Kruger and Johnson (2009) state that the highest score for the resources sector in the survey of 86 South African organisations was 78.33% while that for other industries was 82.95%. The roads consulting industry therefore needs to enhance the use of ICT tools and to create more awareness to staff that it is capable of evaluating, designing and planning an effective ICT infrastructure that supports the promotion of knowledge management activities. What is worrying is that fact that 13% of senior management believe that that the industry is not capable of evaluating, designing and planning an effective ICT infrastructure while only 18% are of the opinion that it is capable.

The survey revealed that the perception in the roads industry as evidenced by the most “yes” responses under the ICT Management section of the questionnaire is:

- The industry is capable **planning** of an ICT system,
- The industry is capable of **evaluating** an ICT system, and
- ICT and the management thereof is seen as an **enabler** of knowledge management

The findings of this research agree with the theory that suggests that the progression of knowledge (as a strategic resource) follows the methodology of the transition of data into information and then into knowledge. What is therefore important for the industry is to manage the ICT assets well (which include human and technology), so that these assets can play a strategic role.

## Section 2: Information Management

Kruger and Johnson (2009) state that apart from testing the extent of the proficiency in information management in the organisation, this section also tests whether information management tools and services are successfully institutionalised. The maximum maturity points possible under this section are 76. The survey attained 43.69 or 58% of the possible points. This maturity level compares well with the study by Kruger and Johnson (2009) which shows a maturity level of 61% for similar industries.

This study also revealed that there are significant differences of opinion between middle and senior management with regard to information management as either a prerequisite to knowledge management or as knowledge management:

	a prerequisite for knowledge management	knowledge management
Operational	- 76%	- 24%
Middle Management	- 71%	- 29%
Senior Management	- 17%	- 83%
Combined	- 58%	- 42%

The differences in opinions above require to be urgently addressed by senior management so as to remove doubts regarding the institutionalisation of information management.

The questions answered with the most “yes” responses under the Information Management section are:

- The organization understands which information resources are crucial to the business
- It is clear which managers are accountable for information resources

It can be inferred from this study that ICT systems within the roads industry have grown to a level where the industry knows what constitutes data and information systems. The consulting environment values the importance of knowledge, recognises the knowledge management function which has now been formalised, and there is a concerted effort to inculcate this realization into all levels of the organization.

### **Section 3: KM Issues (Principles, Policy, Strategy)**

According to Kruger and Johnson (2009), this section addresses questions surrounding awareness of the power vested in knowledge and whether knowledge is seen as a strategic corporate resource. The maturity level attained for this section is 66% which is higher than that obtained in the Kruger (2008) study (52%). The maturity levels attained by the different management levels are 66% (operational), 61% (senior) and 70% (middle).

The study revealed and it can be concluded that the following initiatives have been taken to manage knowledge

- There is a conscious decision to invest in knowledge management
- It is agreed upon that there is a need for hybrid knowledge management environments, i.e. technology and people
- High-ranking knowledge champions are identified
- There is a commitment from top management to the establishment of a formal knowledge management function

The industry however needs to do more in order to enhance the success of its ability to produce, obtain, transfer, capture and share knowledge in a systematic way. It was pointed out by Rosenberg (2001) that despite the need for technology, knowledge management is much about people, working relationships, and communication. As pointed out previously in this report, Rosenberg (2001) believes that live teamwork, collaboration and other forms of person-to-person interaction are essential to create the right balance between the information and the actions of the people.

### **Section 4: Implementation of KM**

This section tests the extent the organisation has set up endeavours or institutionalised initiatives to manage knowledge successfully [Kruger (2009)]. The maturity level attained for this section is 54%. The maturity levels attained by the different management levels are 52% (operational), 49% (senior) and 54% (middle). The maturity level of 53% is higher than the maturity level of similar industries (46.5%) as reported by Kruger (2009).

Kruger and Snyman (2005) state that organizations at this level of maturity are able to determine what constitutes knowledge resources (both tacit and explicit), where knowledge resources are situated (internal and external), and why resources are strategic.

The question (question 4.1) “**in your organization, the following initiatives have been taken and organizational arrangements made**”, based on the variability of the answers provided, revealed that whereas most people have some knowledge regarding the implementation of KM, more action is required to ensure that staff have similar information in order for the staff to know the initiatives that have been taken by their organisations and the organisational arrangements that have been made.

The study has revealed that there is no follow-up to assess the progress made in implementing knowledge management practices (question 4.5). In this regard, the study established that:

- The use of indicators to assess the implementation of knowledge management practices is not practised
- There is no wide spread use of scorecards
- Written/oral feedback from staff on achievements in knowledge management is not done or documented
- Comparisons are not made between other organizations in the industry

Regarding the **culture** (question 4.6), the research showed that:

- Staff now consider that sharing knowledge will be good for their career
- Staff **do not** spontaneously organize knowledge events such as meetings with staff from other divisions/departments
- Staff **do not** make documents available to others more spontaneously

The study has shown that there are difficulties in implementing knowledge management practices, because of the following reasons (question 4.7):

- Lack of time or resources to concretely share knowledge on a day-to-day basis
- Staff do not make documents available to others spontaneously
- Difficulty in capturing employee's undocumented knowledge (know-how)

### **Section 5: Ubiquitous Knowledge**

This section analyses the commitment of the organisation to share and rely on outside knowledge to carry out their daily activities. The maturity level attained for this section is 35%. The research has shown that the Consulting Engineers' ICT architecture is not capable of transcending the borders of the organizations, for example the system is so protected that it is not capable of sharing data, information, knowledge and expertise with any of the stakeholders in the organizations, business circles. It is recommended that Consulting Engineering firms should formulate a knowledge policy to govern the sharing of knowledge across the extended value chain.

### **Section 6: Assessment of KM Growth**

The study revealed that whereas 72% of the senior management believe there was growth in KM within the last five years, that growth was not significant. Only 28% believe there was definite growth. On the whole, 63% of the respondents are of the opinion that there was some growth of KM which was not significant and 34% believe there was definite growth.

## **6 Overall Conclusions**

Going back to the purpose of the study, which was to determine the Knowledge Management Maturity of the roads consulting engineering environment, with the view to establish a baseline upon which future measurements may be based, it was shown that the average maturity in the industry is 54.12%. There was however a marked difference in the determined maturity between senior management (46.26%), middle management (56.69%) and operational management (56.77%).

From the study the researcher concludes that the industry has some good policies and implements robust methods regarding, information storage, and knowledge sharing and transfer. The current management of knowledge that has been created from existing and past projects however needs to be done more efficiently.

The study concludes that knowledge within the industry is gathered and shared mainly through peer and quality reviews, presentations and via e-mail. It can be concluded that staff members do not spend more time on building data bases and therefore databases are not used extensively. It can also be concluded that good work practices within the industry have been outlined in training manuals, and to a lesser extend, in best practice guideline documents.

By analysing how the knowledge component of business activities is treated as an explicit concern of business reflected in strategy, policy, and practice at all levels of the company, the researcher can conclude that the industry has **no** clearly defined knowledge management (KM) policy, has **no** clearly defined Knowledge Management (KM) strategy and, has not communicated the KM strategy widely to staff.

It can also be concluded that the knowledge management maturity model used provided some "insight" to the industry regarding the status of knowledge management in the companies, and highlighted the challenges of what has to be done for improvement. It is certainly hoped that this information may become very beneficial as consulting engineering industry matures in the marketplace.

## 7 Overall Recommendations

Combining the results of the literature study and the results of this research, the following recommendations are made:

- (a) Regarding ICT Management, the consulting engineering industry needs to enhance the use of ICT tools and to create more awareness to staff, to highlight that the industry is capable of evaluating, designing and planning an effective ICT infrastructure that supports the promotion of knowledge management activities. The researcher also recommends that the gap between middle and senior management be narrowed, so that middle management recognises more, ICT as an enabler of knowledge management.
- (b) Regarding Information Management, this study revealed that there are significant differences of opinion between middle and senior management with regard to information management as either a prerequisite to knowledge management or as knowledge management. These differences in opinion require to be addressed by senior management so as to remove doubts regarding the institutionalisation of information management.
- (c) Whereas the formulation of Knowledge Management Principles, Policy and Strategy attained the highest maturity, the industry however still needs to do more with regard to the decentralisation of authority and improving working relations and trust, in order to enhance the success of its ability to produce, obtain, transfer, capture and share knowledge in a systematic way.
- (d) With regard to the implementation of Knowledge Management, it is recommended that the consulting engineering industry institutes a follow-up process in order to assess the progress made in implementing knowledge management practices. Additionally, it is recommended that the industry develops a culture where staff sees the benefit, career wise, of sharing knowledge, and, staff spontaneously organize knowledge events with staff from other divisions/departments.
- (e) In order to assist in the management of ubiquitous knowledge, it is recommended that the industry should formulate a knowledge policy to govern the sharing of knowledge across the extended value chain. This policy should however be governed by the justifiable cost of sustaining an extended knowledge management infrastructure.

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## ANNEXURE 1

### RESEARCH METHODOLOGY

#### Data gathering process

According to Yin (2003), case studies can use one participant, or a small group of participants and that it is important for the participant pool to remain relatively small. The participants can represent a diverse cross section of society, but this isn't necessary. For this study, the participants were carefully chosen from roads related consulting engineering firms, and from organisations involved in the Roads Industry such as the South African National Roads Agency Limited, South African Roads Federation, Society of Asphalt Technology, and the Southern African Bitumen Association. Ethnic and gender diversity were not considered important although all gender and ethnic groups were included in the survey. The distribution of the participants is given below:

	Management Level			
	Operational	Middle	Senior	Combined
Returned completed questionnaires	14	22	11	47
Questionnaires completed via telephone interviews	7	6	7	20
<b>Total number of respondents</b>	<b>21</b>	<b>28</b>	<b>18</b>	<b>67</b>
Number of questionnaires sent out	40	40	40	120
Percentage of questionnaires completed	53%	70%	45%	56%

**Table 8-1: Distribution of participants in the study**

The research was conducted as a qualitative and not as a quantitative case study. Documentation, direct and participant observations, archival records and physical artefacts methods were not considered to be suitable for this research. This left only one source of evidence i.e. interviews. Two kinds of question methods were used: questionnaires and telephone interviews. Firstly, 120 questionnaires were sent out to operational, middle and senior management. When the deadline for receipt of completed questionnaires passed, the researcher and his assistant telephoned some individuals and persuaded them to provide the answers telephonically. Some degree of success was realized.

All the data collected by means of the questionnaire was entered into an Excel spreadsheet for further analysis, using descriptive statistics. The data capturing process was done by an assistant and closely scrutinized by the researcher to eliminate errors. Prior to the commencement of data capturing, the researcher and the assistant carried out a training session to ensure that the capturing was error free – this was important to facilitate effective validation during the data capture process. The data was transferred into a rating system using a Likert scale. Once all the data was captured, the analysis consisted of descriptive statistics for each question by obtaining the frequencies and percentages (verified by ensuring that the cumulative percentages always added to 100, and by ensuring that the cumulative frequency added to the total number (67) of respondents). The data was also arranged, summarised and presented in such a way that meaningful fundamentals of the data could be extracted, manipulated and interpreted. All the figures were created in Microsoft Excel 2007.

## Data analysis

According to Rasooli (2006), analysis is not simply a matter of classifying, categorizing, coding or collating data. Rasooli (2006) says a qualitative researcher has to provide some coherence and structure to this data which is often based on text, field notes or written documents.

Kruger and Snyman (2007) developed a four point Likert scale to express the degree of agreement with the questions put forward which calculated the maturity score expressed as values or percentages. The Likert scale points awarded are shown below:

		<u>Points awarded</u>
<b>Y (1)</b>	- Yes definitely ( <b>Y</b> )	- <b>(4)</b>
<b>S (2)</b>	- Yes, but not <b>S</b> ignificantly ( <b>S</b> )	- <b>(2)</b>
<b>P (3)</b>	- No, but <b>P</b> robably within the next 5 years ( <b>P</b> )	- <b>(1)</b>
<b>N (4)</b>	- <b>N</b> o ( <b>N</b> )	- <b>(0)</b>

The maximum points possible for questions under each section are given below:

- Section 1: ICT Management, q5-q9 (Max Score = 20 points)
- Section 2: Information Management, q10-q28 (Max Score =76 points)
- Section 3: KM Issues (Principles, Policy, Strategy), q29 – q52 (Max Score = 88 points)
- Section 4: Implementation of KM, q53 – q84 (Max Score = 94 points)
- Section 5: Ubiquitous Knowledge, q85 – q103 (Max Score = 76 points)
- Section 6: Assessment of KM Growth, q104 (Max Score = 4 points)

The overall KM maturity was calculated by summing the individual scores attained in the individual sections (20 + 76 + 88 + 94 + 76 + 4 = 358 points). To analyse the data as percentages, the number of points for each section was summed, and divided by the maximum points possible for that section.

## Validity and Reliability

In order to gauge the quality of this research, it is necessary to assess fulfilment of two fundamental criteria i.e. validity and reliability. Validity pertains to whether the research was conducted within the confines of the stated measures i.e. if it has measured what it was expected to measure. In order to ensure validity of this research, the questions used in the interviews were already “tried and tested” in the industry environment because the questionnaire that was used was developed by Kruger and Snyman (2007) and was used by Kruger (2008) in a research survey in which 434 people in 86 organisations participated.

The questions used were also evaluated against the ideals postulated in **TATA’s** 5iKM3 Knowledge Management Maturity Model, which had been evolved by keeping in mind three basic pillars of knowledge maturity - People, Process and Technology.

The questionnaire used also compared to the questionnaire that was used by Statistics Canada in 2001 while conducting a legal survey to measure the extent to which knowledge management practices were used (or will be used) by Canadian businesses.

In order to increase the reliability of this study, the most recent relevant theories have been used to provide an overview of the research problem and to ultimately choose the questionnaire designed by Kruger and Snyman (2007) as the best tool for this research. Reliability and validity was enhanced because of the overlap of information provided and the use of multiple information gathering methods (Sekaran 2000).