

## The Interrelationship between Knowledge Management and Technology Knowledge Management Enabler - A Case study of Employees of Sudanese Ministry of Petroleum and Minerals

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**Abstract:** This study mainly focused on the relationship among the variables of the Knowledge Management Processes (KMP) and the variables of the Technology Knowledge Management Enabler (TKME), the relationship between the knowledge creation KC and the knowledge storage KS, the relationship between the knowledge creation KC and the knowledge distribution KD, the relationship between the knowledge creation KC and the knowledge application KA, the relationship between the knowledge storage KS and the knowledge distribution KD, the relationship between the KS and the KA finally the relationship between the KD and the KA. The paper depends on a simple random sample of size 400 items. A questionnaire of 27 variables or question was used to collect data from employees of Sudanese ministry of petroleum and minerals during January 2019. In the final results, there are positive relationships among the studied variables. There were highly significance positive correlations between the items of the knowledge KC, KS, KD and KA. Also there were highly significance positive correlation between the components of the KMP and the TKME.

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**Keywords:** Statistical Analysis - Knowledge-Management-Technology- Shaqra university-Omdurman Islamic university.

### 1. Introduction

According to Hana (2012), employees and generally human resources are indispensable components for organizations. The competitive advantage of organizations lays mainly in the way their employees use their knowledge, experience and skills (Chai, Wang, Song, Haiman & Brombacher, 2012; Argote & Ingram, 2002). All employees have knowledge independently of the kind of jobs they do (Wang & Wang, 2012; Beazley, Boenisch, & Harden, 2002). Today the intangible assets are in the capital of knowledge and are the most important and the most valuable things for organizations (Levy, 2011; Cabrera, Collins, & Salgado, 2006; Beazley et al., 2002; Drucker, 1985). To use knowledge capital effectively it is very important that there is continuous (continual) knowledge transfer, especially inside the organization. Every employee must have the necessary knowledge, experience and skills needed for their work when the previous incumbent leaves the organization (Eucker, 2007; Leonard, 2005). Retaining as much knowledge continuity as possible ensures the minimum of amount change (Levy, 2011). This can

help address human resources problems (for example letter of resignation, death of employee).

Knowledge Management is the explicit and systematic management of vital knowledge - and its associated processes of creation, organization, diffusion, use and exploitation.

Knowledge assets have often become more important to companies than financial and physical assets and are often the only way for a company to distinguish itself from its competitor & gain competitive advantage.

Lost knowledge given the enormous of baby boomers that will be changing jobs or retiring in next few years cause productivity cost of an employee leaving 85% of their base salary due to their replacement's mistakes, lost knowledge and lost skill (Beazley et al, 2002)

Relate to the concept of knowledge half-life, from which it is found that knowledge reaches obsolescence, on average, in 500 days, but can be much quicker in some areas.

- Lost knowledge obviously has a cost, estimated that \$115 billion sits idle in lost knowledge affiliated with production technologies.

- An astounding example of this is the loss of the original computer source code, written in the 1950's, that spawned the Y2K software crisis, has cost businesses worldwide an estimated \$1 trillion (Petch, 1998), Dalkir, (2011)

This paper presents the concept of mastery of knowledge management process and its importance, and the relationships between the items of the knowledge management process and the relationship with Applied study on the employees of the Sudanese ministry of petroleum and minerals. This paper concentrated on knowledge management process and technology knowledge management enabler. There are other papers will study knowledge team, business process management and decision making process.

This paper cares about the descriptive and the inferential statistics in collecting and analyzing data.

**1-2 Research Problem**

Military governments that have governed Sudan for more than 50 years were not priorities and interests of knowledge management and its requirements. A strong relationships are expected between components of the KMP and the TKME.

**1-3 Research Objectives**

To identify the relationships that connect the elements of KMP and the TKME.

**1-4 Hypotheses**

H1: There is a positive relationship among the variables of the (KMP) and the variables of the (TKME).

H2: There is a positive relationship between the KC and the KS

H3: There is a positive relationship between the KC and the KD

H4: There is a positive relationship between the KC and the KA

H5: There is a positive relationship between the KS and the KD

H6: There is a positive relationship between the KS and the KA

H7: There is a positive relationship between the KD and the KA

H8: There is a positive relationships between the TKML from one side and KC, KS, KD and KA from other side.

**1-5 Definition of the variables:**

The variables KMP1, KMP2,..., KMP32 were defined in the attached questionnaire in the appendix1 and the variables TKME33, TKME34,..., TKME37 were defined in the attached questionnaire in the appendix2. The Knowledge Creation (KC) was the average of the variables KMP1, KMP2,..., KMP7. The Knowledge Storage (KS) was the average of the variables KMP8, KMP9,..., KMP15. The Knowledge Distribution (KD) was the average of the variables KMP16, KMP17,..., KMP25. The Knowledge Application (KA) was the average of the variables KMP26, KMP27,..., KMP32. The Technology Knowledge Management Enabler (TKME) was the average of the variables TKME33, TKME34,..., TKME37.

**1-6 Determination of the sample size:**

A simple random sample of the employees of Sudanese ministry of petroleum and minerals was used in this research.

Formula (1) was used to determine the sample size.

$$n = \frac{z^2 pq}{e^2} \rightarrow (1)$$

n is the required sample size

P is the percentage occurrence of a state or condition

q = 1- p

e is the percentage maximum error required

Z is the value corresponding to level of confidence required

By putting z=2, p=q=0.5 and e=0.05 we have n=400

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**2- Analysis of Data**

Table (1) shows total Cronbach's Alpha, that was 0.937. In table (2), there is no Cronbach's Alpha greater than 0.937 therefore, all variables should be in the questionnaire.

**Table (1): Reliability Statistics**

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.937	.936	37

**Table (2): Item-Total Statistics**

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
KMP1	138.90	324.762	.600	.	.938
KMP2	138.69	329.392	.499	.	.939
KMP3	138.55	334.884	.284	.	.940
KMP4	138.44	333.720	.322	.	.940
KMP5	138.93	320.737	.612	.	.938
KMP6	138.85	325.324	.522	.	.938
KMP7	138.90	326.516	.473	.	.939
KMP8	138.95	324.301	.553	.	.938
KMP9	138.75	324.293	.543	.	.938
KMP10	138.94	324.175	.552	.	.938
KMP11	138.87	323.761	.612	.	.938
KMP12	138.69	323.919	.574	.	.938
KMP13	139.04	321.648	.552	.	.938
KMP14	138.91	328.237	.447	.	.939
KMP15	138.92	322.319	.585	.	.938
KMP16	138.85	322.113	.611	.	.938
KMP17	138.64	335.269	.309	.	.940
KMP18	138.77	328.869	.516	.	.938
KMP19	138.55	329.216	.503	.	.939
KMP20	138.94	326.778	.529	.	.938
KMP21	138.95	325.359	.571	.	.938
KMP22	138.73	330.546	.458	.	.939
KMP23	138.85	323.311	.619	.	.938
KMP24	138.77	329.169	.454	.	.939
KMP25	139.62	324.522	.374	.	.941
KMP26	138.75	327.954	.574	.	.938
KMP27	138.83	327.759	.595	.	.938
KMP28	138.89	326.943	.559	.	.938
KMP29	139.03	327.378	.469	.	.939
KMP30	138.88	327.022	.613	.	.938
KMP31	138.81	327.448	.542	.	.938
KMP32	138.91	322.270	.651	.	.937
TKME33	138.86	322.129	.674	.	.937
TKME34	139.11	320.106	.616	.	.938
TKME35	139.02	323.842	.684	.	.937
TKME36	139.07	325.892	.455	.	.939
TKME37	138.87	322.618	.626	.	.937

Table 3 shows that, KMO and Bartlett's test. The sample size is quite enough because KMO measure was 0.846, which is greater than 0.5 and because, the

P-value (Sig.) was 0.000, the number of the variables was suitable for the study.

**Table (3): KMO and Bartlett's Test**

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.846
Bartlett's Test of Sphericity	Approx. Chi-Square	8530.876
	df	666
	Sig.	0.000

Table 4 shows that, most of the correlation coefficients among the variables of the Knowledge Management Process (KMP) and the variables of the

Technology Knowledge Management Enabler (TKME) were highly significance. There were no significant correlation between TKME33 and KMP17,

TKME34 and KMP3, TKME35 and KMP4, TKME36 and KMP14, TKME36 and KMP19. Only five pairs of variables out of 160 pairs of variables have

insignificant correlation, that means 97% of the variables have positive significant correlation.

**Table (4): Correlation Coefficients Among The Variables of The (KMP) and The Variables of The (TKME)**

		TKME33	TKME34	TKME35	TKME36	TKME37
KMP1	Correlation Coefficient	.327**	.320**	.295**	.234**	.350**
	Sig. (2-tailed)	.000	.000	.000	.000	.000
	N	400	400	400	400	400
KMP2	Correlation Coefficient	.373**	.257**	.312**	.209**	.272**
	Sig. (2-tailed)	.000	.000	.000	.000	.000
	N	400	400	400	400	400
KMP3	Correlation Coefficient	.102*	.048	.143**	.129**	.233**
	Sig. (2-tailed)	.042	.335	.004	.010	.000
	N	400	400	400	400	400
KMP4	Correlation Coefficient	.187**	.110*	.048	.138**	.103*
	Sig. (2-tailed)	.000	.027	.336	.006	.040
	N	400	400	400	400	400
KMP5	Correlation Coefficient	.431**	.422**	.461**	.212**	.325**
	Sig. (2-tailed)	.000	.000	.000	.000	.000
	N	400	400	400	400	400
KMP6	Correlation Coefficient	.237**	.196**	.260**	.007	.275**
	Sig. (2-tailed)	.000	.000	.000	.893	.000
	N	400	400	400	400	400
KMP7	Correlation Coefficient	.261**	.281**	.212**	.202**	.253**
	Sig. (2-tailed)	.000	.000	.000	.000	.000
	N	400	400	400	400	400
KMP8	Correlation Coefficient	.455**	.398**	.448**	.273**	.265**
	Sig. (2-tailed)	.000	.000	.000	.000	.000
	N	400	400	400	400	400
KMP9	Correlation Coefficient	.431**	.181**	.290**	.139**	.281**
	Sig. (2-tailed)	.000	.000	.000	.005	.000
	N	400	400	400	400	400
KMP10	Correlation Coefficient	.345**	.237**	.406**	.338**	.216**
	Sig. (2-tailed)	.000	.000	.000	.000	.000
	N	400	400	400	400	400
KMP11	Correlation Coefficient	.403**	.405**	.485**	.333**	.446**
	Sig. (2-tailed)	.000	.000	.000	.000	.000
	N	400	400	400	400	400
KMP12	Correlation Coefficient	.308**	.343**	.452**	.319**	.315**
	Sig. (2-tailed)	.000	.000	.000	.000	.000
	N	400	400	400	400	400
KMP13	Correlation Coefficient	.442**	.394**	.429**	.191**	.251**
	Sig. (2-tailed)	.000	.000	.000	.000	.000
	N	400	400	400	400	400
KMP14	Correlation Coefficient	.462**	.197**	.314**	.076	.178**
	Sig. (2-tailed)	.000	.000	.000	.131	.000
	N	400	400	400	400	400
KMP15	Correlation Coefficient	.350**	.354**	.299**	.192**	.389**
	Sig. (2-tailed)	.000	.000	.000	.000	.000
	N	400	400	400	400	400
KMP16	Correlation Coefficient	.344**	.302**	.400**	.200**	.415**
	Sig. (2-tailed)	.000	.000	.000	.000	.000
	N	400	400	400	400	400

KMP17	Correlation Coefficient	.050	.322**	.259**	.291**	.320**
	Sig. (2-tailed)	.316	.000	.000	.000	.000
	N	400	400	400	400	400
KMP18	Correlation Coefficient	.388**	.316**	.333**	.285**	.209**
	Sig. (2-tailed)	.000	.000	.000	.000	.000
	N	400	400	400	400	400
KMP19	Correlation Coefficient	.285**	.135**	.284**	.075	.251**
	Sig. (2-tailed)	.000	.007	.000	.134	.000
	N	400	400	400	400	400
KMP20	Correlation Coefficient	.400**	.381**	.429**	.253**	.243**
	Sig. (2-tailed)	.000	.000	.000	.000	.000
	N	400	400	400	400	400
KMP21	Correlation Coefficient	.398**	.391**	.392**	.249**	.332**
	Sig. (2-tailed)	.000	.000	.000	.000	.000
	N	400	400	400	400	400
KMP22	Correlation Coefficient	.244**	.314**	.331**	.208**	.278**
	Sig. (2-tailed)	.000	.000	.000	.000	.000
	N	400	400	400	400	400
KMP23	Correlation Coefficient	.478**	.483**	.402**	.222**	.233**
	Sig. (2-tailed)	.000	.000	.000	.000	.000
	N	400	400	400	400	400
KMP24	Correlation Coefficient	.260**	.384**	.249**	.183**	.225**
	Sig. (2-tailed)	.000	.000	.000	.000	.000
	N	400	400	400	400	400
KMP25	Correlation Coefficient	.248**	.239**	.250**	.116*	.139**
	Sig. (2-tailed)	.000	.000	.000	.020	.005
	N	400	400	400	400	400
KMP26	Correlation Coefficient	.264**	.355**	.471**	.300**	.360**
	Sig. (2-tailed)	.000	.000	.000	.000	.000
	N	400	400	400	400	400
KMP27	Correlation Coefficient	.497**	.412**	.365**	.198**	.340**
	Sig. (2-tailed)	.000	.000	.000	.000	.000
	N	400	400	400	400	400
KMP28	Correlation Coefficient	.403**	.353**	.395**	.317**	.321**
	Sig. (2-tailed)	.000	.000	.000	.000	.000
	N	400	400	400	400	400
KMP29	Correlation Coefficient	.310**	.452**	.356**	.289**	.265**
	Sig. (2-tailed)	.000	.000	.000	.000	.000
	N	400	400	400	400	400
KMP30	Correlation Coefficient	.536**	.327**	.433**	.183**	.330**
	Sig. (2-tailed)	.000	.000	.000	.000	.000
	N	400	400	400	400	400
KMP31	Correlation Coefficient	.423**	.454**	.437**	.335**	.409**
	Sig. (2-tailed)	.000	.000	.000	.000	.000
	N	400	400	400	400	400
KMP32	Correlation Coefficient	.433**	.375**	.381**	.215**	.341**
	Sig. (2-tailed)	.000	.000	.000	.000	.000
	N	400	400	400	400	400
*. Correlation is significant at the 0.05 level (2-tailed).						
**. Correlation is significant at the 0.01 level (2-tailed).						
Correlation with red color is insignificant at the 0.05 level (2-tailed).						

Table 5 shows that, all the correlation coefficients among the Knowledge Creation (KC),

Knowledge Storage (KS), Knowledge Distribution (KD), Knowledge Application (KA) and Technology

Knowledge Management Enabler (TKME) were highly significance.

**Table (5): Correlations among KC, KS, KD, KA and TKME**

		TKME	KC	KS	KD	KA
TKME	Pearson Correlation	1	.619**	.710**	.696**	.750**
	Sig. (2-tailed)		.000	.000	.000	.000
	N	400	400	400	400	400
KC	Pearson Correlation	.619**	1	.716**	.739**	.623**
	Sig. (2-tailed)	.000		.000	.000	.000
	N	400	400	400	400	400
KS	Pearson Correlation	.710**	.716**	1	.764**	.643**
	Sig. (2-tailed)	.000	.000		.000	.000
	N	400	400	400	400	400
KD	Pearson Correlation	.696**	.739**	.764**	1	.727**
	Sig. (2-tailed)	.000	.000	.000		.000
	N	400	400	400	400	400
KA	Pearson Correlation	.750**	.623**	.643**	.727**	1
	Sig. (2-tailed)	.000	.000	.000	.000	
	N	400	400	400	400	400

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

Table 6 shows that, the sample size, mean, median, mode, standard deviation, minimum and maximum value of the variables of the research.

**Table (6): Descriptive Statistics of the variables**

		KMP1	KMP2	KMP3	KMP4	KMP5	KMP6	KMP7	KMP8	KMP9	KMP10
N	Valid	400	400	400	400	400	400	400	400	400	400
	Missing	0	0	0	0	0	0	0	0	0	0
Mean		3.82	4.03	4.17	4.29	3.79	3.88	3.82	3.77	3.97	3.78
Median		4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Mode		4	4	4	4	4	4	4	4	4	4
Std. Deviation		.850	.767	.802	.806	1.008	.938	.961	.938	.953	.945
Minimum		1	2	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5	5

Belongs to table (6)

		KMP11	KMP12	KMP13	KMP14	KMP15	KMP16	KMP17	KMP18	KMP19
N	Valid	400	400	400	400	400	400	400	400	400
	Missing	0	0	0	0	0	0	0	0	0
Mean		3.86	4.03	3.68	3.81	3.80	3.87	4.09	3.95	4.18
Median		4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Mode		4	4	4	4	4	4	4	4	4
Std. Deviation		.877	.924	1.065	.913	.980	.951	.713	.769	.770
Minimum		1	1	1	1	1	1	1	2	1
Maximum		5	5	5	5	5	5	5	5	5

Belongs to table (6)

		KMP20	KMP21	KMP22	KMP23	KMP24	KMP25	KMP26	KMP27	KMP28
N	Valid	400	400	400	400	400	400	400	400	400
	Missing	0	0	0	0	0	0	0	0	0
Mean		3.78	3.77	4.00	3.87	3.95	3.11	3.98	3.90	3.83
Median		4.00	4.00	4.00	4.00	4.00	3.00	4.00	4.00	4.00
Mode		4	4	4	4	4	4	4	4	4
Std. Deviation		.856	.863	.764	.888	.848	1.307	.739	.723	.805



Minimum	1	1	1	1	1	1	2	2	1
Maximum	5	5	5	5	5	5	5	5	5

Belongs to table (6)		KMP29	KMP30	KMP31	KMP32	TKME33	TKME34	TKME35	TKME36	TKME37
N	Valid	400	400	400	400	400	400	400	400	400
	Missing	0	0	0	0	0	0	0	0	0
Mean		3.69	3.85	3.91	3.82	3.86	3.62	3.70	3.65	3.85
Median		4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Mode		4	4	4	4	4	4	4	4	4
Std. Deviation		.922	.735	.804	.890	.867	1.029	.788	1.030	.908
Minimum		1	2	2	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

### 3- Results (Finding):-

- The sample size and the number of the variables are suitable for the research.
- All the assumed hypotheses are investigated and found correct.
- 97% of the variables have positive significant correlation.
- 3% of the variables have insignificant correlation.
- Most of the correlation coefficients among the variables of the **KMP and the variables of the TKME** were highly significance.
- All the correlation coefficients among the Knowledge Creation (KC), Knowledge Storage (KS), Knowledge Distribution (KD), Knowledge Application (KA) and Technology Knowledge Management Enabler (TKME) were highly significance.

### 4- Conclusion:-

- There are significant correlations among The variables of the KMP and the variables of TKME.
- There are mutual effect between the KMP and the TKME.
- The KMP and the TKME will not separate.

### 5- Recommendations:-

- Sudanese Ministry of Petroleum and Minerals should be interested the KMP and the TKME.
- To do further study including knowledge team, business process management and decision making process.
- Perform the same study in other Sudanese ministries.

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**Appendix**

## Appendix 1: Knowledge Management Process (KMP)

	Variable	I: Knowledge Creation:	Please tick				
			SD	D	N	A	SA
1	KMP1	A number of mechanisms have been used to create or acquire knowledge from different sources such as volunteers, clients, donors or competitors.					
2	KMP2	Policies are placed to allow employees to present new ideas without fear and ridicule.					
3	KMP3	It is important to capture the experiential knowledge of staff for organisational use.					
4	KMP4	It is important to capture lessons learnt at various stages of the project					
5	KMP5	The experiential knowledge of staff is usually converted into written documents accessible to the organisation.					
6	KMP6	Staff are encouraged to find alternative solutions to promote construction projects.					
7	KMP7	New knowledge is usually created to solve specific problems during project development.					
	Variable	I: Knowledge Creation:	Please tick				
			SD	D	N	A	SA
8	KMP8	Different mechanisms are used for collating sources and types of knowledge.					
9	KMP9	There is a standard process for storing reference material such as policies, procedure manuals, standards, guidelines, strategies, directory of expertise, ideas, notable successes or other practical information.					
10	KMP10	Databases or information technologies are utilized to store reference material.					
11	KMP11	Various written documents such as newsletters or manuals to store captured information from employees and others are available.					
12	KMP12	There is a register or database of skills, expertise and knowledge sources.					
13	KMP13	Records and written documents are used to store knowledge.					
14	KMP14	Computer and other digital information media storage are used.					
15	KMP15	There is a system to control the tangible knowledge assets.					
	Variable	III: Knowledge Distribution	Please tick				
			SD	D	N	A	SA
16	KMP16	knowledge in a form that is readily accessible to employees.					
17	KMP17	There are libraries, resource centres or other forums to disseminate knowledge or expertise. Like					
18	KMP18	There are regular symposiums, lectures, conferences, or training sessions to share knowledge and ideas.					
19	KMP19	Key domain experts are readily identified and contacted.					
20	KMP20	It is easy to find out who knows in my organisation.					
21	KMP21	Metaphorical representation and imaging of knowledge are utilised to distribute knowledge.					
22	KMP22	There are team works and regular meetings to transfer knowledge.					
23	KMP23	Documents, publications and internal information network are used to distribute knowledge.					
24	KMP24	Training and openness in the exchange of thought and dialogue are applied to distribute knowledge.					
25	KMP25	Experienced staff members are encouraged to mentor the novice staff members					
	Variable	IV: Knowledge Application:	Please tick				
			SD	D	N	A	SA
26	KMP26	Individuals are asked to keep stored knowledge current and up to date					
27	KMP27	Outcomes from previous experiments feed into the new organisation's projects to improve them					



28	KMP28	There are mechanisms to convert knowledge into action plans.						
29	KMP29	There is a policy to review information on a regular basis.						
30	KMP30	There are mechanisms for developing new ideas or ways of doing things from existing practices.						
31	KMP31	Barriers that stop individuals, experts and administrators from reaching to the knowledge are removed.						
32	KMP32	Staff members are encouraged to apply their implicit knowledge and experience to subsequent projects.						

**Appendix2: Technology Knowledge Management Enabler (TKM)**

	Variable		Please tick				
			SD	D	N	A	SA
33	TKME33	My organisation keeps pace quickly with changes in technology. Technology is up-to-date in organisation					
34	TKME34	There is a use of office automation systems (E- mail, automated retrieval of information, word processing, audio-video conferences) to carry out administrative tasks.					
35	TKME35	Artificial intelligence systems are used in organisation.					
36	TKME36	Information <b>technology</b> infrastructure is available.					
37	TKME37	Information <b>technology</b> supports collaborative work and intra-organisation communication					

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