Information Technology Support to Knowledge Management Practices: A Structural Equation Modeling Approach

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There has been a transformation from an era of information scarcity to information surplus, so the key global pressures on management are knowledge identification, creation and dissemination. Development of Knowledge Management (KM) is represented as one of the most significant management movements in such an environment. KM has significantly benefited from Information Technology (IT). However, the extant literature has little practical support for this statement. Based on a review of literature, this paper attempts to develop an instrument and test the conceptual model linking KM and technology, using the Structural Equation Modeling (SEM) technique. Primary data was collected from three SMEs of north India—Software, Pharmaceuticals and Textile industries. The study model confirmed a positive relationship between IT and KM practices in the selected SMEs.

Introduction

Knowledge Management (KM) and Information Technology (IT) are becoming inextricably interwoven. The developments in these two fields are reinforcing each other. IT is an essential consideration for any organization wishing to manage its knowledge assets. It changes how organizations develop, trade, compete and interact with other organizations and support the constantly evolving knowledge practices. It provides capabilities to improve decision-making skills of employees and support the transformation of individual information into organizational knowledge (Karacapilidis *et al*., 2006). An effective technical infrastructure with appropriate searching, abstracting and indexing processes affect knowledge reuse (Behboudi, 2006).

Many IT tools are available to achieve the aim of KM. These tools help in capturing knowledge and expertise created by knowledge workers and making it available to a larger community. The three types of tools used in KM are: (1) Knowledge repositories, which provide document and information databases, search engines, and intelligent agents; (2) Expert directories, such as yellow pages and knowledge maps; and (3) Collaborative tools, such as groupware, e-mail, listserv, newsgroups, chat, and conferencing (Bernard, 2006). KM portal, Internet, Intranets, video-conferencing, document management systems, bulletin boards, shared databases, electronic mail systems, artificial intelligence and knowledge maps are some of the tools used in KM process. These tools create a platform for knowledge contribution, sharing and reusing for the employees of the organization. The important

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knowledge gaps can be identified and promoted with the help of these tools. It also helps the employees to get involved in creating knowledge for business continuity.

Literature Review

Mathew (2009) defined that IT played a crucial role in organizing, sharing, collaboration, categorizing, dissemination and storing knowledge which can later be retrieved and accessed for appropriate usage in different contexts. Matlay and Martin (2009) examined through an illustrative longitudinal case study of a pan-European virtual team comprising 24 e-entrepreneur members, and evaluated the emergent collaborative and competitive strategies used in small e-businesses. It reported that SMEs use Internet to facilitate online knowledge-sharing in the extension of the existing networks or entirely new 'virtual' initiatives.

Schneckenberg (2009) discussed that IT Tools like Web 2.0 tools, in particular Wikis, Blogs, and Real Simple Syndication (RSS) enhance communication with the customers and suppliers on core business processes like product design and development and they encourage collaboration and knowledge exchange between employees.

According to Song (2009), IT infrastructure facilitates knowledge sharing, knowledge creation, knowledge storage and knowledge transfer through better internal communication flows. Andersson and Hermansson (2009) highlighted IT systems as one of the seven potential mechanisms to assimilate repatriate knowledge.

Sáenz *et al*. (2009) applied Structural Equation Modeling (SEM) based on Partial Least Squares (PLS) and highlighted that IT, employees and processes, have a positive effect on knowledge sharing effectiveness. Technology intensity moderates the degree of relevance of each innovation capability in value creation.

Ahmad and Khan (2009) used the qualitative approach by interviewing software industries. It concluded that IT served as a cost-effective and a fast medium to acquire, store, share and transfer knowledge, and played a role in leveraging knowledge and creating new knowledge in the company.

Guerra (2009) used multilevel analysis on 32 participants among managers and employees from the eight international subsidiaries of the PROACT Group and discussed that IT system through an intranet platform allows the different units to transfer, access and adopt knowledge in an efficient way, in terms of cost reduction, time saving, information storage and increasing networking.

The applicability of IT in KM implementation has been identified and proved by many researchers. Agrawal *et al.* (2010) advocated that an effective KM requires an appropriate combination of institutional, social and managerial initiatives along with deployment of appropriate technology. Crilly *et al.* (2010) stated that IT supported and enhanced organizational processes of knowledge creation, storage, retrieval and transfer by coding and sharing of best practices, e.g., benchmarks; the creation of corporate knowledge directories, or mapping of internal expertise; and the creation of knowledge networks, e.g., online forums in specialist areas. Technologies that support the KM practices include knowledge directories, e.g., yellow pages and knowledge networks, e.g., electronic communities of practice and Electronic Knowledge Repositories (EKRs), which store codified knowledge for future reuse, including databases about client and customers, industry best practices and product knowledge.

Vaccaro *et al.* (2010) analyzed the impact of Knowledge Management Tools (KMTs) on the performance of business units involved in inter-firm collaborative innovation projects and found that a more intense use of KMTs has a direct positive effect on new product performance and speed to market as well as on financial performance.

Research Methodology

Judgmental-cum-convenience sampling technique was adopted where a sample of 300 respondents was collected from the SMEs of three states of North India, viz., Punjab, Haryana and Himachal Pradesh in three industries: Textiles, Software and Pharmaceutical. A questionnaire (refer Appendix) was used to collect data from the top level managers like Chief Executives Officers (CEO), Chief Knowledge Officers (CKO), Chief Information Officers (CIO), HR executives and other management experts of the organization.

Out of the 300 SMEs contacted, 260 responses were received. Out of 260 responses, 10 responses were invalid as the questionnaire was not complete. 250 responses were found to be usable. The overall response rate was 83% (Table 1).

Table 1: Sample Size and Response Rate

S. No.	Industry	No. of SMEs	Response Rate
1.	Textiles	100	90%
2.	Software	100	80%
3.	Pharmaceutical	100	80%

Research Instrument

The first part of the questionnaire measured the role of IT tools in KM Practices. The first question contained 10 measurement statements (Table 2) which were rated on a 5-point Likert type scale ranging from Strongly Agree (5) to Strongly Disagree (1).

The second part dealt with the performance implications of IT-enabled KM practices. The measurement items were speed, accuracy, easy reliability, visibility, security, control, cost-effectiveness, KM process improvement, decision support, employee participation, operational efficiency, documentation, cross-unit performance, competence, completeness, systematic storage and integration of systems. These items were rated on a 5-point Likert type scale ranging from Strongly Agree (5) to Strongly Disagree (1) (Table 3).

Reliability of the Instrument

A reliability test was carried out to determine the quality of the measurement items. Cronbach's alpha method was used to assess the reliability of the instrument (Table 4).

Table 2: Measurement Items of Penetration of IT in KM Practices		
Construct	IT in KM Practices (IT)	
Label	Measurement Items	Sources
IT1	IT facilitates the processes of capturing, categorizing, and retrieving knowledge and ideas.	• Goh *et al.* (2010) • Crilly *et al.* (2010) • Vaccaro *et al.* (2010) • Schneckenberg (2009) • Guerra (2009) • Sáenz *et al.* (2009) • Wang *et al.* (2009) • Mathew (2009) • Song (2009) • Huimin *et al.* (2008) • Ray (2008) • Matsuo and Smith (2008) • Vaast (2007) • Haas and Hansen (2007)
IT2	IT tools are used to access external information and knowledge on competitors and market changes.	
IT3	IT tools facilitate communications effectively when face-to-face communications are not convenient.	
IT4	IT tools increase the accuracy and speed of classifying knowledge.	
IT5	IT tools enhance the visibility of knowledge.	
IT6	IT tools reduce the risks of not finding key knowledge.	
IT7	IT tools quickly find documents and people in the organization who have specific knowledge.	
IT8	IT tools support collaborative works regardless of the time and place.	
IT9	IT tools support systematic storing.	
IT10	IT tools provide faster response to queries.	

Table 3: Performance of IT-Enabled KM Practices		
Construct	Performance of IT-Enabled KM Practices (PI)	
Label	Measurement Items	Sources
PI1	Speed and Accuracy	• Agrawal *et al.* (2010) • Crilly *et al.* (2010) • Vaccaro *et al.* (2010) • Song (2009) • Ahmad and Khan (2009) • Guerra (2009) • Hsu (2008)
PI2	Easy	
PI3	Reliability	
PI4	Visibility	
PI5	Security	
PI6	Cost-Effectiveness	
PI7	Control	
PI8	KM Process Improvement	
PI9	Employee Participation	
PI10	Decision Support	
PI11	Operational Efficiency	
PI12	Documentation	

Table 3 (Cont.)

Construct	Performance of IT-Enabled KM Practices (PI)	
Label	**Measurement Items**	**Sources**
PI13	Cross-Unit Performance	• Ray (2008) • Liao and Wu (2009) • Tanriverdi (2005)
PI14	Competence	
PI15	Completeness	
PI16	Integration of Systems	
PI17	Systematic Storage	

Table 4: Reliability of the Instrument

S. No.	Construct	Cronbach's Alpha
1.	Information Technology in KM Practices (IT)	0.819
2.	Performance of IT-Enabled KM Practices (PI)	0.816

The statistics tests showed that Cronbach's alpha of the constructs indicates satisfactory internal consistency reliability. Relatively high values of reliability implied that the instruments used in this study were adequate.

Results and Discussion

The 17 measurement items were examined using exploratory factor analysis. The principal component analysis was adopted for extracting the factors based on latent root criterion (i.e., eigenvalue >1). The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was conducted for comparing the magnitudes of the observed correlation coefficients to the magnitudes of the partial correlation coefficients. Higher values of KMO measure indicated that a factor analysis of the variables was a good idea.

KMO equals to 0.89 at a significance level of 0.000 with chi-square 7,979.64 (Table 5) showed that the degree of common variance among the variables was quite high; therefore, factor analysis could be conducted.

Table 5: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.890
Bartlett's Test of Sphericity	Approx. Chi-Square	7979.640
	df	136.000
	Sig.	0.000

Three factors had eigenvalues of more than one. The percentages of variance extracted by Factors 1 to 3 were 33.236, 31.024 and 27.370, respectively. The cumulative percentage of variance accounted for 91.628% of the total variations extracting three factors from 17 variables. The three extracted factors were allotted appropriate names on the basis of the underlying items. The names of the factors and factor loadings are summarized in Table 6.

Table 6: Naming of Factors and Factor Loadings

Factor	Label	Measurement Items	Factor Loading	Eigenvalue	% of Variance
Operational Support	PI3	Reliability	0.963	5.650	33.236
	PI4	Content Visibility	0.946		
	PI5	Security	0.973		
	PI12	Documentation	0.946		
	PI15	Completeness	0.982		
	PI17	Systematic Storage	0.988		
Strategic Development	PI8	KM Process Improvement	0.956	5.274	31.024
	PI9	Employee Participation	0.952		
	PI10	Decision Support	0.990		
	PI13	Cross-Unit Performance	0.990		
	PI14	Competence	0.990		
	PI16	Integration of Systems	0.990		
Process Improvement	PI1	Speed and Accuracy	0.985	4.653	27.370
	PI2	Easy	0.948		
	PI6	Cost-Effectiveness	0.919		
	PI7	Control	0.970		
	PI11	Operational Efficiency	0.964		
Total Variance					91.628

- Factor I: Operational support represented the operational support for KM practices and included six items: reliability, content visibility, security, documentation, completeness and systematic storage; and explained 33.236% of the total variance.

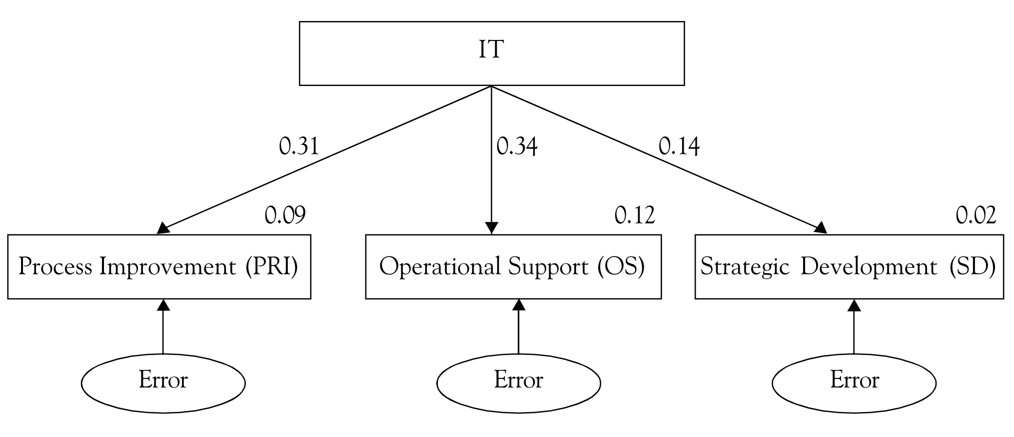
- Factor II: Strategic development included: competence, KM process improvement, employee participation, decision support, cross-unit performance and integration of systems; and explained 31.024% of the total variance.

- Factor III: Process improvement illustrated KM process improvement and included five measurement items: speed and accuracy, easy, cost-effectiveness, control and operational efficiency; and explained 27.370% of the total variance.

Structural Equation Modeling (SEM)

A path model was developed to find the impact of IT-enabled KM practices on 'Process Improvement' (PI), 'Operational Support' (OS) and 'Strategic Development' (SD) of the organization (Figure 1). The arrow leading from IT-enabled KM practices to process improvement indicates that the process improvement depended, in part, on IT-enabled KM practices. The variable errors were enclosed in a circle because they were not directly observed. The model had seven parameters to be estimated and 10 sample moments with 3 degrees of freedom).

Figure 1: Path Model



Path Loadings of the Model

In the structural model, path loading represents the predictive links among the constructs. It shows significant relationship fit between variables and its indicators. These path loadings of the models and the probability level are summarized in Table 7.

Table 7: Path Loading and Probability Level of the Model

Model	Path	Path Loading	Probability Level
1	OSß IT_KM	0.34	***
	SDß IT_KM	0.14	0.024
	PRIß IT_KM	0.31	***

In this model, the highest value of path loading was for operational support (0.34), followed by strategic development (0.31), which predicted that IT tools provided the operational support to KM practices by increasing the visibility, reliability, security, documentation, completeness and systematic storage of the knowledge.

Overall Model Fit

The last step involved was to test the model fit. The overall goodness-of-fit was assessed to ensure that the model was correctly specified. Model fit determines the degree to which the sample data fit the SEM model. Model fit criteria used in the study are chi-square (χ^2), Root Mean Square Error of Approximation (RMSEA), Root Mean Residual (RMR), the Goodness-of-Fit Index (GFI), the Adjusted Goodness-of-Fit Index (AGFI), Comparative Fit Index (CFI), Normed Fit Index (NFI), Incremental Fit Index (IFI) and Tucker-Fit-Index (TFI).

The χ^2 test was considered an absolute test for model fit. If the probability was below 0.05, the model was accepted. The other measures of fit are descriptive. The recommended value of RMSEA was less than or equal to 0.08. The smaller the value of RMSR, the better was the fit. GFI varies from 0 to 1 and a value greater than 0.90 indicates a good fit. AGFI was a variant of GFI which uses mean squares instead of total sum of squares in the numerator and denominator of 1. The AGFI varies from 0 to 1. NFI values vary from 0 to 1, with 1 being the perfect fit. CFI close to 1 indicates a very good fit and values above 0.90 are considered to be an acceptable fit. Goodness-of-fit measures and their acceptable levels for SEM are provided in Table 8.

Table 8: Goodness-of-Fit Measure for SEM

Goodness-of-Fit Measure	Model 3			Level of Accepted Fit
	S	P	T	
Degree of Freedom		3		
P-Level (Probability Level)	0.011	0.008	0.000	Below 0.05
Chi-Square (χ^2)	11.07	11.95	25.35	
RMR	0.011	0.037	0.081	Smaller Value
GFI	0.940	0.926	0.890	>0.90
AGFI	0.801	0.755	0.632	>0.90
CFI	0.962	0.132	0.518	>0.90
NFI	0.949	0.267	0.516	>0.90

Note: S – Software industry; P – Pharmaceutical industry; and T – Textiles industry.

The overall model fit was calculated for all the three industries. GFI of the model in all the industries was above the acceptable value. The other model fit measures were within the acceptable level for software industry, but in pharmaceutical and textiles industries, AGFI, CFI and NFI were not satisfactory. However, on the basis of GFI and probability levels (Table 8), we can accept the models.

Conclusion

IT is an indispensable part of KM practices in software SMEs. IT enhanced the visibility of knowledge and facilitated the processes of capturing, categorizing and retrieving knowledge and ideas in the organization. IT tools help in accessing the external information and knowledge on competitors and market changes. IT tools facilitated communications and support for collaborative works regardless of time and place. The study found that the IT tools reduced the risks of not finding key knowledge and increase the accuracy and speed of classifying knowledge and systematic knowledge storage. The respondents supported that IT tools quickly found documents and people in the organization that had specific knowledge and helped in providing faster response to their queries.

IT tools improved the KM process by increasing the speed, accuracy, cost-effectiveness, better control and operational efficiency and made the implementation of KM practices easier. IT provided operational support to KM practices by increasing the content visibility, proper documentation, completeness and systematic storage of knowledge. IT tools provided better security and more reliability to the KM system. Strategic development was the third area of IT-enabled KM practices in selected industries. These IT-enabled KM practices enhanced the strategic development of the organization by improving KM process, competence, employee participation, decision support, cross-unit performance and better integration of systems. ■

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Appendix

Questionnaire: Knowledge Management Practices

This survey was to measure the extent to which Knowledge Management Practices are used or will be used by Indian businesses. A highly mobile and aging workforce has increased the need for a better set of knowledge retention, acquisition, sharing and transfer Practices. Data collected in this survey will result in a greater understanding of Knowledge Management Practices to support enhanced learning and performance by organizations. Your cooperation was essential for the results of the survey to be valid and reliable.

You are requested to fill the following questionnaire and the data so gathered will be used strictly for the purpose of the research and the respondent identity will not be revealed to anyone.

Part I: Demographic Profile

Name of the Organization ....

Name of the Respondent ....

Gender	
Male	
Female	
Age (Years)	
25-45	
45-65	
> 65	
Educational Qualifications	
Graduates	
Postgraduates	
Professionally Qualified	
Turnover (₹)	
Upto 20 lakh	
20 lakh-60 lakh	
60 lakh-1 crore	
1 crore and above	

Appendix (Cont.)

Part II: Knowledge Management Practices

Q1. Please rate the extent to which each statement was accurate about the Knowledge Management Practices in your organization

S. No.	Statements	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
		5	4	3	2	1
1.	The organization actively captures external knowledge from industrial associations, competitors, clients and suppliers.					
2.	The organization captures knowledge from public research institutions, universities and government laboratories.					
3.	Has dedicated resources for acquisition and obtaining internal knowledge from experienced workers and managers.					
4.	Encourages workers to participate in project teams with external experts.					
5.	Has a culture intended to promote knowledge sharing.					
6.	Has policies or programs intended to improve knowledgeable worker retention.					
7.	Problems, failures, experiences and method of working are discussed openly and avoid making similar mistakes in the future.					
8.	Regular meetings are done for discussion of professional projects.					
9.	Databases of good work Practices, lessons learned, skills and listings of experts are regularly updated.					
10.	Written documentation of lessons learned, training manuals, good work practices and articles was done.					
11.	The information systems and knowledge stored in the systems are constantly upgraded.					

Appendix (Cont.)

S. No.	Statements	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
		5	4	3	2	1
12.	People are encouraged to access and use knowledge saved in company systems.					

Part III: Information Technology

Q 5. Please rate the extent to which each statement was accurate about the IT usage in your organization.

S. No.	Statements	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
		5	4	3	2	1
1.	IT facilitates the processes of capturing, categorizing, storing, and retrieving knowledge and ideas in our organization.					
2.	IT tools are used to access external information and knowledge on competitors and market changes.					
3.	IT tools facilitate communications effectively when face-to-face communications are not convenient.					
4.	IT tools increase the accuracy and speed of classifying knowledge.					
5.	IT tools enhance the visibility of knowledge in our organization.					
6.	IT tools reduce the risks of not finding key knowledge.					
7.	IT tools quickly find documents and people in the organization who have specific knowledge.					
8.	IT tools support for collaborative works regardless of time and place.					
9.	IT tools support systematic storing.					
10.	IT tools provides faster response to queries.					

Appendix (Cont.)

Q 6. In your organization, rate the extent of use of following IT tools for knowledge transfer, sharing and storing:

S. No.	IT Tools	Very High	High	Medium	Low	Very Low
		5	4	3	2	1
1.	Intranets					
2.	Internet					
3.	Portals					
4.	DBMS/KBS					
5.	Groupware					
6.	Data Warehousing/Mining					
7.	e-Document Management System					
8.	Dedicated KM Software					

Q 7. In your organization, please rate the performance implications of IT track KM Practices

S. No.	Parameters	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
		5	4	3	2	1
1.	Speed and Accuracy					
2.	Easy					
3.	Reliability					
4.	Visibility					
5.	Security					
6.	Cost-Effectiveness					
7.	Control					
8.	KM Process improvement					
9.	Employee Participation					
10.	Decision Support					
11.	Operational Efficiency					
12.	Documentation					
13.	Cross-Unit Performance					
14.	Competence					
15.	Completeness					
16.	Integration of Systems					
17.	Systematic Storage					

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