Knowledge Resource Quality, Knowledge Management Process Capability, and Effectiveness – A Simulation Approach

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Abstract

This paper analyses the importance of knowledge resource quality in the context of a knowledge management environment in Information Technology sector. The exogenous variable of this study is knowledge resource quality, and the endogenous variables are knowledge management process capability and knowledge management effectiveness. This research is conducted in the context of information technology sector in India. System Dynamics approach is used for this research which consists of five different steps of problem identification, system conceptualization, model formulation, simulation & validation, and policy analysis & improvement. Data for this research was collected through a survey questionnaire. The survey was conducted in large Indian IT companies, and the data was collected from 423 knowledge workers of 63 IT companies in India. Multiple linear regression equations were developed between the independent and dependent variables of the study. These equations were used to develop the stock and flow diagram, and the model was simulated under four different scenarios. The results highlight the importance and leverage provided by knowledge resource quality for improving KM process capability and effectiveness. Managerial implications are provided to help IT managers to take strategic and operational decisions for improving KM performance.

Keywords: *knowledge management; knowledge management process capability; knowledge resource quality; knowledge management effectiveness; system dynamics.*

1. Introduction

Knowledge management (KM) now finds its place in the functional structure of modern day organizations. Various researchers (Quinn et al., 1996; Shih & Chiang, 2005; Hallin & Marnburg, 2008) define KM as an exercise to develop and capture individual and team knowledge to create an organizational memory. KM also makes organizations become more flexible and enable them to become learning organizations. In an era where rapid changes are happening in the global business environment, organizations must adapt to become competitive for which knowledge is an active enabler.

The software organizations in India or the information technology (IT) sector have played a significant part in the resurgence of the Indian economy over the past decade. In the Indian Information Technology (IT) sector there has been a thrust towards efficient managing of knowledge assets, owing to its importance in ensuring sustainability. KM enables IT organizations to gain insight from its own experience and deal with these challenges (Singh & Soltani, 2010). Applying KM in a sector like information technology (IT) can have many positive impacts (Schneider, 2009). It enables faster implementation of software projects without one having to compromise on the quality of the output. It also helps in improving communication within the organization and makes individuals more independent in carrying out their knowledge work. KM helps to group tasks more efficiently and recognize problems much faster which reduces the work time on an activity, thereby freeing resources for other tasks. KM also increases an organization's agility to take up a wide range of projects which are more complex and difficult to handle.

In the current global economy, the IT sector is the most knowledge-intensive, as they are highly reliant on the experience and knowledge of an individual worker, which exists mostly in the tacit form. How well an organization captures this knowledge is critical to the survival of any IT organization. For such organizations, their most significant asset is their intellectual capital which lies mostly within the minds of people. The primary objective of KM being implemented in an IT company would be to develop an organizational memory so that it can become more knowledge-centric rather than people-centric. (Shirazi et al., 2011). Realising this potential of KM, the IT industry was one of the early adopters of the same, to augment their survival in a highly volatile business environment.

It is under this background this study has been conducted to understand the influence of the quality of knowledge management resources (KMR) on knowledge management process capability (KMP) and knowledge management effectiveness (KME). The methodology used for this study is System Dynamics (SD), and simulation is carried out to know the extent to which KMR could influence KMP and KME.

2. Literature review

The theoretical background of the constructs used in this research is explained in this section.

2.1. Knowledge Management Resources (KMR)

In the modern knowledge, economy knowledge is considered as a tangible resource (Wong, 2005). Knowledge resource in an organization can be in the tacit form or explicit form (Nonaka, 1994). In IT organizations, both these forms of knowledge are essential, and the interaction of these two are required for the creation of new knowledge (Nonaka, 1994). Several researchers have proposed knowledge management resource as a critical factor that influences KME. Human resources are needed to coordinate and manage the process of KM implementation as well as to take up knowledge related roles in an organization (Wong, 2005). The availability of knowledge resources should be a primary concern in KM implementation and should be given higher importance (Holsapple & Joshi, 2000; Wong, 2005). Past researchers have pointed the positive influence of knowledge resources on new knowledge creation and innovation (Amara et al., 2009; Abbas et al., 2018). Knowledge management resource has been proposed by several researchers as a critical factor that influences KME (Jennex & Olfman, 2004; Akhavan et al., 2006; Chang et al., 2009; Gai & Xu, 2009; Abbaszadeh et al., 2010; Lehner & Haas, 2010; Milosz & Milosz, 2010; Zieba & Zieba, 2014). KMR in this research includes factors such as knowledge availability, expertise capability, resource access and intellectual capital.

2.2. Knowledge Management Process Capability (KMP)

The KM Initiative is often considered as a combination of the People, Process and Technology dimensions. The KM Processes ensure the growth and sustainability of a KM program in an organization (Zecca & Rastorgueva, 2017). Hence the KM process capability is that which levers the success of a Knowledge Management System. Researchers have tried to explain the various processes which are involved in a KMS (Cross & Baird, 2000; Jennex & Olfman, 2000; Choi, 2000; Barna, 2003; Wong, 2005; Muhammed et al., 2008). In the context of this research, KMP is the capability of KM in terms of creation of new knowledge, acquisition, & sharing of existing knowledge and applying the knowledge for knowledge work (Gold, 2001; Hasanali, 2002; Jennex & Olfman, 2004; Wong, 2005; Chong, 2006; Yang et al., 2010; Sedighi & Zand, 2012; Zeidi & Babaheidari, 2015, Karami et al., 2015; Enshassi et al., 2016).

2.3. Knowledge Management Effectiveness (KME)

KME is a measure of how well the KM has been performing in an organization. Davenport et al. (1997) explained KME regarding the growth of KM resources, increase in knowledge content & use, and financial return. Gold et al. (2001) connected KME to innovativeness, coordination, time to market, adaptability, and responsiveness. Chou et al. (2005) measure KME as the perceived satisfaction of the knowledge workers whereas Brachas et al. (cited in Chen, 2009) viewed KME regarding perceived usefulness. Mithas et al. (2011) explain KME regarding customer management capability, process management capability, and performance management capability. Basu & Ray (2015) linked KME to business process, learning, product/service quality, productivity, innovation, profitability, responsiveness and cost reduction. In the context of this research, KME is considered from an outcome point of view, and the sub-dimensions are improved communication, enhanced collaboration, improved employee skills, better decision making and improved productivity (Anantatmula & Kanungo, 2005).

3. Research Methodology

This research follows the System dynamics (SD) methodology proposed by Sterman (2000) which has five stages which are inter-related viz., Problem Identification, System Conceptualization, Model formulation, Simulation & validation, and Policy analysis & improvement (Sterman, 2000).

3.1. Problem identification

The problem statement for this research is to study the dynamics of knowledge management resource quality, knowledge management process capability and knowledge management effectiveness to understand the leverage offered by KMR on the endogenous variables. This can enable in suggesting policies for improving KME in an IT organization. The independent variable of this research is KMR, the mediating variable is KMP, and the dependent variable is KME. The dimensions of the SD model are developed based on literature review. A systems approach is used while modelling to interconnect the different variables of the system to understand the interaction effect of these factors on determining KME. SD modelling and simulation is done using Vensim® PLE V5.11A software.

3.2. System Conceptualization

The second stage of SD model development is system conceptualization. This stage involves developing a causal loop diagram (CLD) for representing the feedback structure of systems. CLD shows variables of the study and its causal relations by assigning a polarity, either positive (+) or negative (-) to represent how the dependent variable changes concerning the independent variable. The CLD for this research was developed based on a literature review by identifying the significant factors that may influence KMP and KME. According to systems perspective, to understand the actual behavior of the system, the model should be comprehensive and consider all the significant factors and its interrelationships (Senge, 1990). Also for taking strategic decisions, it is always recommended to use systems approach as the impact is long-term (Veselovsky et al., 2018). Although the focus of this research is only to study the influence of KMR on KMP and KME, this cannot be analyzed in isolation. Hence, the factors included in the model apart from KMR are the various success factors of KM such as human resource management (HRM), KM organization (KOR), KM strategy (KST), leadership (LDR), KM technology (KMT), KM culture (KMC) and KM measurement (KMM) which are identified through literature review (Figure 1). However, the scope of this paper is limited to the analysis of KMR and its influence on KME and KMP.

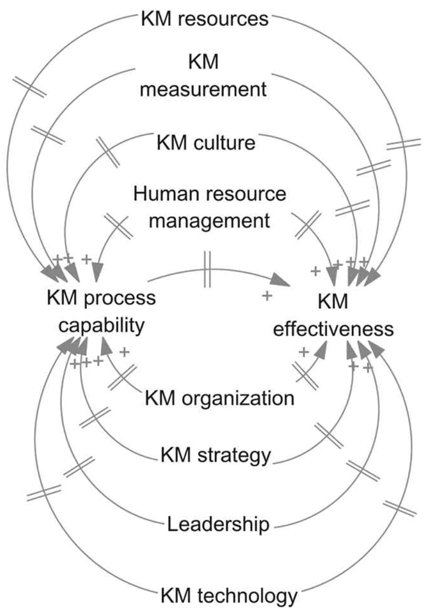


Figure 1.
Causal loop diagram of factors influencing KM effectiveness

3.3. Model development

After the CLD is developed the next stage of SD methodology is model formulation. In this step, the CLD is converted to a stock and flow diagram (Figure 2 and Figure 3). The mathematical equations between the variables of the study need to be developed to aid model development. The equations are developed based on the data collected from the knowledge workers of the IT sector in India. A Likert scale type questionnaire survey was conducted for capturing the perceptions about the variables of the model depicted in the CLD. 423 responses were received from knowledge workers from 63 large Indian IT companies which are listed on the Bombay stock exchange (BSE).

The relationships between the variables of the study were developed using multiple linear regression methods. The stocks of this SD model are the success factors of KM including KMR, and the dependent variables KMP and KME. The stock KMR which is the focus of this research has sub-dimensions such as human resource availability, knowledge sources, knowledge asset quality, and expertise capability. The rate variable 'ratein(kmr)' of the KMR stock is the rate at which KMR improves over a period of time. The rate variable 'rateout(kmr)' of the KMR stock is the rate in which KMR declines over a period of time. The constant variable 'policy(kmr)' is used to simulate the model under different KMR performance rates to study its impact on KMP and KME. The variable 'policy(kmr)' can take values ranging from 0 to 3. When 'policy(kmr)=0" it indicates that the model is simulated concerning the existing situation in the IT sector and the performance is evaluated. The policy variable value is then changed to 1, 2 and three under three different simulation runs to analyze the KME performance under three different conditions – the low growth of KMR (25%), the medium growth of KMR (50%) and high growth of KMR (75%). There are two delay variables 'delayin(kmr)' and 'delayout(kmr)' considered for model development. The variable 'delayin(kmr)' represents the delay in months taken for the policy implementation to get fully realized in an organization (assumed to be six months). The delay variable 'delayout(kmr)' indicates the delay for the current KMR performance to decline in the organization (assumed to be two months).

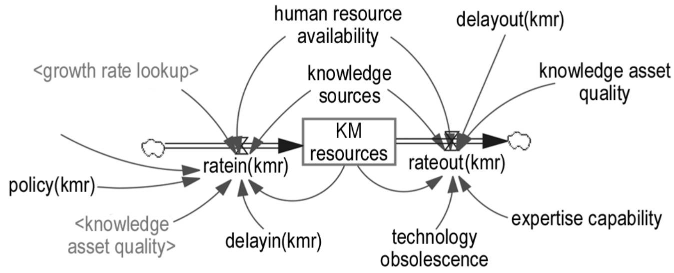
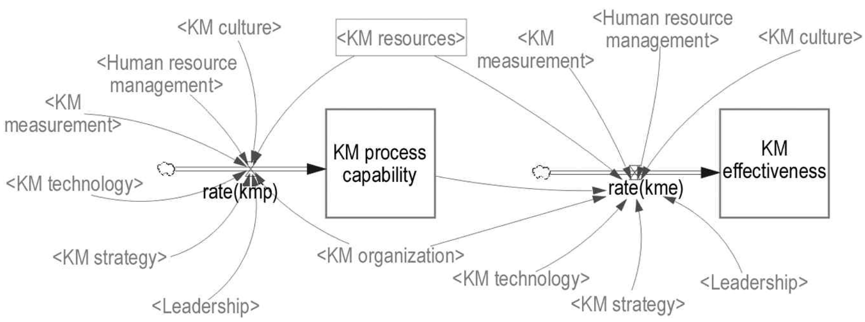


Figure 2. Stock and flow diagram of KMR

Figure 3.
Stock and flow diagram for KMP and KME



3.4. Simulation and Validation

Before using the SD model for policy evaluation, it needs to be validated by performing a set of validation steps which will help in establishing confidence in the usefulness of the model (Coyle, 1977). The validation procedure also determines if the SD model is close to real life representation (Giannanasi et al., 2001). Although there are no universal methods followed by researchers for establishing the validity of the SD model, validating the model using different approaches increases the level of confidence in the model results (Forrester & Senge, 1980). In this research, the validation procedures proposed by Sterman (2000) was used for testing the model which included validating model structure, validating model behavior and validating policy implications.

3.5. Policy Analysis and Improvement

The last and the most critical stage in simulation research is policy analysis and improvement which will enable the researcher to evaluate different policies based on the model simulation under different conditions. In this study, the policy variables are the sub-dimensions of KMR which are human resource availability, knowledge sources, knowledge asset quality, and expertise capability. These variables are given four different values subjecting to four different simulation runs. The first condition was the base run where the model was simulated concerning the existing situation in the industry to see if it is sustainable. In the second condition, all the policy variables were given 'low growth' (25%). The third and fourth conditions were 'medium growth' (50%) and 'high growth' (75%). The results of the simulation are presented in the following section.

4. Results and Discussion

The survey conducted among 66 large Indian IT companies yielded 423 responses with a response rate of 23%. The respondents were from different locations in India, the majority being from the large IT hubs such as Bangalore, Chennai, Mumbai and National Capital Region. The mean scores and perceptions of the significant variables of the study are shown in Table 1. It can be observed that the general perception of the variables of the study was above average.

Dimension	Mean	Std. Dev.	Bad (1) (%)	Poor (2) (%)	Average (3) (%)	Good (4) (%)	Very Good (5) (%)
KMR	3.989	0.802	1	8	16	43	32
KMP	3.896	0.777	1	9	18	44	28
KME	3.940	0.709	1	7	16	49	27

Table 1. Descriptive statistics of constructs

The respondents of the survey were knowledge workers of Indian IT sector who had an experience of greater than one year in the respective organization. They belonged to designations of Project Manager and below. Out of the 423 respondents, 241 were software engineers (57%), 104 were project leads (25%), and 78 were project managers (18%).

4.1. Multiple Linear Regression Analysis

To develop mathematical relationships between the independent and dependent variables of the study, multiple linear regression analysis was conducted using IBM SPSS V22.0 software. These equations will be used for stock and flow simulation of the SD model. Two regression equations have been developed based on the data collected. The first equation explains the direct influence of success factors including KMR on KME (Tables 2, 3 & 4). The second equation explains the direct influence of success factors including KMR on KMP (Tables 5, 6 & 7).

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.904a	0.817	0.813	0.33574
a. Predictors: (Constant), KMM, KMC, KST, HRM, LDR, KMR, KMT, KOR				

Table 2. Model Summary for regression – KMP

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	207.798	8	25.975	230.438	.000a
	Residual	46.666	414	0.113		
	Total	254.463	422			
a. Predictors: (Constant), KMM, KMC, KST, HRM, LDR, KMR, KMT, KOR						
b. Dependent Variable: KMP						

Table 3. ANOVA results for regression – KMP

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	.092	.096		.957	.339
	KMC	.069	.038	.067	1.798	.073
	HRM	.043	.040	.044	1.081	.280
	KMT	.169	.046	.177	3.671	.000
	KST	.169	.046	.179	3.650	.000
	KOR	.135	.047	.145	2.890	.004
	LDR	.099	.043	.099	2.282	.023
	KMR	.166	.043	.171	3.897	.000
	KMM	.126	.030	.131	4.200	.000
a. Dependent Variable: KMP (R-square: 0.817)						

Table 4.
The coefficients of regression – KMP

The regression equation for KMP (Table 4) is given by:

KMP = 0.092 + 0.069*KMC + 0.043*HRM + 0.169*KMT + 0.169*KST + 0.135*KOR + 0.099*LDR + 0.166*KMR + 0.126*KMM [1]

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.931a	.866	.863	.26222
a. Predictors: (Constant), KMM, KMC, KST, HRM, LDR, KMR, KMT, KMP, KOR				

Table 5. Model Summary for regression – KME

ANOVA[b]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	183.522	9	20.391	296.568	.000a
	Residual	28.397	413	.069		
	Total	211.919	422			
a. Predictors: (Constant), KMM, KMC, KST, HRM, LDR, KMR, KMT, KMP, KOR						
b. Dependent Variable: KME						

Table 6. ANOVA results for regression – KME

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	.293	.075		3.911	.000
	KMC	.163	.030	.173	5.400	.000
	HRM	.022	.031	.024	.697	.486
	KMP	.111	.038	.121	2.887	.004
	KMT	.110	.037	.126	3.004	.003
	KST	.030	.037	.035	.821	.412
	KOR	.113	.037	.132	3.047	.002
	LDR	.101	.034	.110	2.956	.003
	KMR	.238	.034	.269	7.032	.000
	KMM	.040	.024	.046	1.686	.093
a. Dependent Variable: KME						

Table 7.
The coefficients of regression – KME

The regression equation for KME (Table 7) is given by:

KME = 0.293 + 0.163*KMC + 0.022*HRM + 0.111*KMP + 0.110*KMT + 0.030*KST + 0.113*KOR + + 0.101*LDR + 0.238*KMR + 0.040*KMM [2]

4.2. Simulation and Policy Analysis

4.2.1. Inferences

The stock and flow model was simulated for four different runs for a period of 60 months. The performance of KME and KMP are evaluated on a scale of 0 to 1 where 0 indicates no performance and 1 indicates 100% performance. The first run was to understand the 'as-is' situation in the Indian IT sector (base run). For this, all the independent variables were set to the means scores obtained from the survey. This run explains the current performance of KMP and KME as explained by KMR variables. This simulation helps to understand the sustainability of the KM programme under the conditions and also provides a reference of comparison for other simulation runs. The base run condition shows improvement in an exponential growth in KMP up to 12 months. After 12 months the KMP declines in performance due to different factors influencing the system such as technology obsolescence, attrition rate resulting in loss of intellectual capital, explicit knowledge becoming obsolete, etc. However, the KMP pulls back to the track and stabilizes its performance and reaches a peak performance of 80% around the 36th month. However, when the performance of KMR is reduced to a low (25%) as shown in Run 2 (Figure 4), the KMP growth and decline patterns are like base run but the peak performance of 80% is not achieved is not sustainable over a period of 60 months. Runs 3 and 4 indicate the KMP performance when KMR rate of improvement is medium (50%) and high (75%). As indicated in figure 4, there is a substantial improvement in the performance of KMP for Run 3 and Run4 compared to base run. This clearly indicates that improving the current levels of KMR in IT sector can result in higher KM process capability. The peak performance of KMP achieved in 60 months is 85% and 90% respectively underscoring the importance of KMR in establishing KMP in an organization.

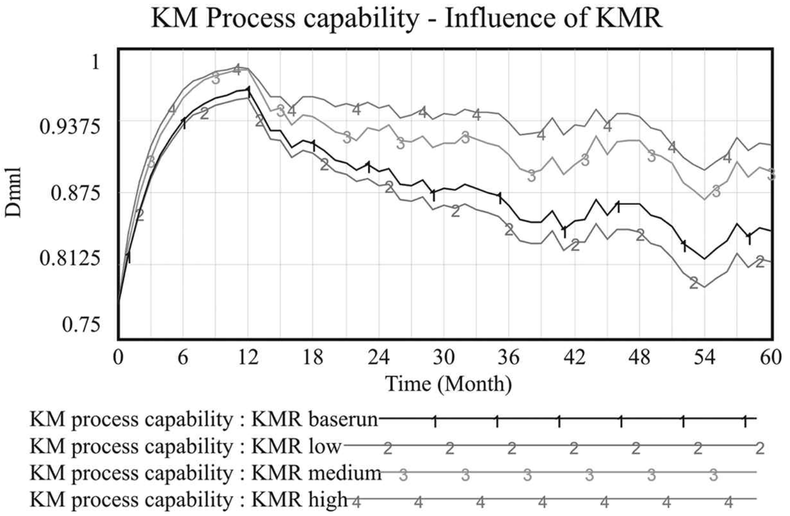


Figure 4.
Knowledge Process Capability Index with varying KMR

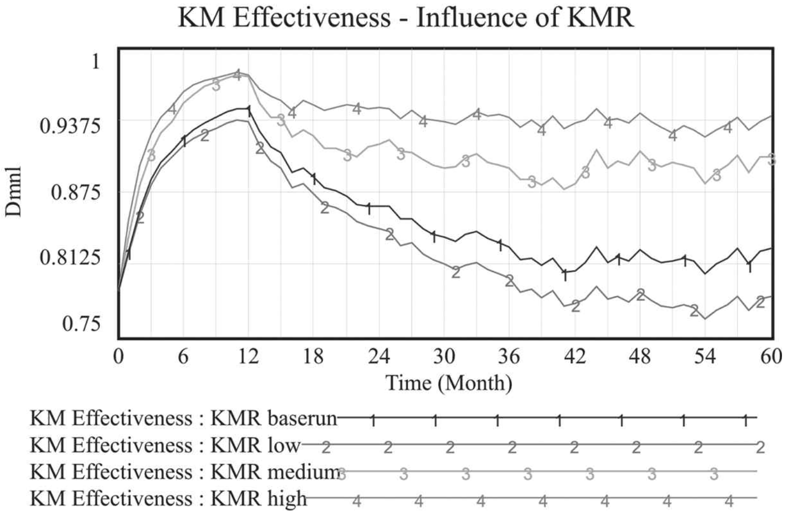


Figure 5.
Knowledge Management Effectiveness index with varying KMR

The next variable under consideration is KME which evaluates the effectiveness of KM in the long run under different conditions of KMR (Figure 5). Run 1 indicates the base run which is based on the current KMR scenario prevailing in IT sector which is obtained through data collection. The KME performance has similar trends like KMP owing the fact that KMP is a mediating variable between KMR and KME. The initial performance of KMP base run (Run1) shows exponential growth up to a time of 12 months. After one year, the factors that pull the system down gains strength and a downward trend is observed. However, the run 1 (base run) and run 2 (25%, low KMR) policies are not sustainable over a long run. If the KMR performance is improved by 50% (Run 3), the KME reaches a peak performance of 88% which stabilizes by 24 months with less variation. However, the performance of KME increases to 95% in 24 months and stabilizes around 90% by 60 months when the KMR improvement is high (Run4). The leverage offered by the factor KMR for KME is large and significant.

4.2.2 Managerial Implications

The managerial implications of this study are as follows:

For having a substantial improvement in KMP, it is required to have a minimum growth rate of 50% of KMR from the existing scenario. The actual performance of KMR does not result in a sustainable KM process capability. Quality of KM resources should be consistently improved which can result in better KMP. IT organizations should focus on having KM teams which can provide necessary support for the KM activities in software projects. The human resource should be trained on core competencies for enhancing their knowledge that could eventually result in new knowledge creation. The experts in various domains of IT should be identified and made available for software teams for any knowledge transfer requirements. Employees in an IT firm should be given enough time apart from their regular work for participating in KM activities such as sharing, applying and reusing of knowledge.

To achieve higher levels of KM effectiveness, the scenario is not different either. The quality of knowledge resources significantly influences the KME in an organization. There should be consistent monitoring of knowledge stored in the repository by performing knowledge audits. The obsolete knowledge should be removed from the archives, and the new knowledge should be consistently stored. Developing an intellectual capital for the organization substantially helps the KM program to be instrumental. As it is evident from the simulation, the gains obtained by KME is substantial when KMR is improved. This underscores the fact that KMR is a high leverage critical success factor for KM in IT organizations. Knowledge-intensive IT sector hugely relies on up to date knowledge for its day to day operations. The knowledge workers can upgrade their knowledge only if they are provided with quality knowledge resources. The quality of knowledge resources should be equally suitable for both the types of knowledge – tacit and explicit.

Maintaining high-quality tacit knowledge resources implies that the organization should have a pool of experts for each domain of work. Experts can also be developed as knowledge workers gain experience in the organization or through external recruitment. In any case, maintaining adequate tacit knowledge quality is desirable for sustaining the KM program in the organization. Explicit knowledge storage has been a significant concern for IT companies as they need to distinguish between useful knowledge and old knowledge. Having a knowledge repository with obsolete knowledge does not serve any purpose. In the same way, having a knowledge repository with low-quality knowledge resources also can be detrimental to the growth of the company. Hence the focus of IT companies should be to maintain knowledge assets which are of high quality and at the same time useful for the knowledge workers of the organization.

5. Conclusion, Limitations and Future Scope

The current study was aimed at analyzing the performance of KM regarding KME and KMP as explained by KMR. SD methodology was used to explain the performance of KM concerning the change in KM resource quality. The data collected from the Indian IT sector was fed into the system and simulated for a period of 60 months. The results of the simulation showed that how important a factor is KMR for the success of KME. The leverage offered by KMR for improvement of KMR and KME is highly significant. Hence organizations should focus more on building quality knowledge resources in the organization to improve KM performance and ultimately innovation in the organization.

One of the significant limitations of this study is that the research was limited to only one CSF of KM, that is the knowledge management resources. The other factors may be equally important with should be further explored. A thorough analysis of all the factors individually will determine the relative importance of KMR concerning other factors of the model. Another limitation of this research is that purely quantitative approach was used for this study. It is recommended to extend this research by exploring the results further through qualitative methods such as interviews, focus group discussion, observation etc. Another future scope of this research is to extend the study to small-medium scale IT organizations to see if any variation in results exists. The study can also be extended to other industry to conduct a sector level comparison. The SD model itself can be expanded further to include more variables into picture such as cultural and technological issues to study its' impact on KM process capability and effectiveness. This addition will help to develop a comprehensive model for better understanding the dynamics of a holistic KM initiative.

References

[1] Abbas, A., Avdic, A., Xiabao, P., Zhao, S.L., and Chong, R. (2018). Strategic framework of collaboration in knowledge transfer of high-tech industries, *Quality-Access to Success*, 19(163), 74-80.

[2] Abbaszadeh, M. A., Ebrahimi, M. & Fotouhi, H. (2010). Developing a causal model of critical success factors for knowledge management implementation, *in Education and Management Technology (ICEMT), 2010 International Conference on Education and Technology*, 701-705. doi: 10.1109/ICEMT.2010.5657563.

[3] Akhavan, P., Jafari, M., & Fathian, M. (2006). Critical success factors of knowledge management systems: a multi-case analysis, *European Business Review*, 18(2), 97-113. http://doi.org/10.1108/09555340610651820

[4] Amara, N., Landry, R., & Doloreux, D. (2009). Patterns of Innovation in Knowledge-Intensive Business Services, *The Service Industries Journal*, 29(4), 407-430. doi:10.1080/02642060802307847

[5] Anantatmula, V., & Kanungo, S. (2005). Establishing and Structuring Criteria for Measuring Knowledge Management Efforts, *Proceedings of the 38th Annual Hawaii International Conference on System Sciences*, https://doi.org/10.1109/HICSS.2005.247

[6] Barna, Z. (2003). *Knowledge Management: A Critical E- Business Strategic Factor*, Unpublished Masters Thesis, San Diego State University.

[7] Basu, B., & Ray, P. K. (2014). Measuring and Evaluating KM Capability in an Organization: An Exploratory Case Study, *Vine*, 44(2), 6. https://doi.org/10.1108/VINE-05-2013-0026

[8] Chang, M. Y., Hung, Y. C., Yen, D. C., & Tseng, P. T. Y. (2009). The research on the critical success factors of knowledge management and classification framework project in the Executive Yuan of Taiwan Government, *Expert Systems with Applications*, 36(3 PART 1), 5376–5386. http://doi.org/10.1016/j.eswa.2008.06.060

[9] Chen, L. (2009). What individual-level antecedents influence knowledge management effectiveness, *Journal of Knowledge Management Practice*, 10(2). Retrieved from http://www.tlainc.com/articl186.htm

[10] Choi, Y. S. (2000). An empirical study of factors affecting successful implementation of knowledge management, *Doctoral dissertation*, The University of Nebraska, Lincoln. Retrieved from http://digitalcommons.unl.edu/dissertations/AAI9991981

[11] Chong, S. C. (2006). KM critical success factors, *The Learning Organization*, 13(3), 230-256. http://doi.org/10.1108/09696470610661108

[12] Chou, T.C., Chang, P.L., Tsai, C.T. & Cheng, Y.P. (2005). Internal learning climate, knowledge management process and perceived knowledge management satisfaction, *Journal of Information Science*, 31(4), 283-296.

[13] Coyle, R. G. (1977). *Management System Dynamics*, John Wiley and Sons, Chichester.

[14] Cross, R. & Baird, L. (2000). Technology Is Not Enough: Improving Performance by Building Organizational Memory – ProQuest, *Sloan Management Review*, 41(3), 69-78. Available at: http://search.proquest.com/openview/6376a88bb2fc31c0310c224cd1b4ab28/1?pq-origsite=gscholar.

[15] Davenport, T. H., De Long, D. W., & Beers, M. C. (1997). Building successful knowledge management projects. *Center for business innovation working paper*, 4. http://www.providersedge.com/Docs/Km_Articles/Building_Successful_KM_Projects.Pdf
[16] Enshassi, A., Falouji, I., AlKilani, S., & Sundermeieri, M. (2016). Knowledge Management Critical Success Factors in Construction Projects, *International Journal of Sustainable Construction Engineering and Technology*, 7(1), 69-84.
[17] Forrester, J. W., & Senge, P. (1980). Tests for building confidence in System Dynamics Models, *TIMS Studies in the Management Sciences*, 14, 209-228
[18] Gai, S., & Xu, C. (2009). Research of Critical Success Factors for Implementing Knowledge Management in China, *International Conference on Information Management, Innovation Management and Industrial Engineering*, 561-564. http://doi.org/10.1109/ICIII.2009.594
[19] Giannanasi, F., Lovett, P., & Godwin, A. N. (2001). Enhancing confidence in discrete event simulations, *Computers in Industry*, 44, 141-157.
[20] Gold, A. H. (2001). *Towards a Theory of Organizational Knowledge Management Capabilities* (PhD Dissertation), University of North Carolina, Retrieved from http://legacy.cf.ac.uk/infos/resource/dissertations/Goldthesis.pdf
[21] Hallin, C.A., & Marnburg, E. (2008). Knowledge management in the hospitality industry: a review of empirical research, *Tourism Management*, 29(2), 366-381.
[22] Hasanali, F. (2002). Critical success factors of knowledge management. *Knowledge Management Advantage*, (September), 1-4. http://doi.org/10.1108/09555340610651820
[23] Holsapple, C. W. and Joshi, K. D. (2000). An investigation of factors that influence the management of knowledge in organizations, *The Journal of Strategic Information Systems*, 9, 235–261. doi: 10.1016/S0963-8687(00)00046-9.
[24] Jennex, M. E., & Olfman, L. (2004). Assessing knowledge management success/effectiveness models, *Proceedings of the 37th Annual Hawaii International Conference on System Sciences*, http://doi.org/10.1109/HICSS.2004.1265571
[25] Karami, M., Alvani, S. M., Zare, H., & Kheirandish, M. (2015). Success Factors for Knowledge Management Implementation , Using Qualitative and Quantitative Tools, *Iranian Journal of Management Studies (IJMS)*, 8(2), 181–201.
[26] Lehner, F., & Haas, N. (2010). Knowledge Management Success Factors – Proposal of an Empirical Research, *Electronic Journal of Knowledge Management*, 8(1), 79-90. Retrieved from http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=psyc7&NEWS=N&AN=2010-16313-008
[27] Milosz, M. & Milosz, E. (2012). Critical Success Factors and Barriers to Implementation of Knowledge Management Systems at Polish SMEs, *Actual Problems of Economics*, (May), pp. 309-315.
[28] Mithas, S., Ramasubbu, N. & Sambamurthy, V. (2011). How information management capability influences firm performance, *MIS Quarterly*, 35(1), 237-256.
[29] Muhammed, S., Doll, W. J., & Deng, X. (2008). Exploring the relationships among individual knowledge management outcomes. *Proceedings of the 41st Hawaii International Conference on System Sciences*, https://doi.org/10.1109/HICSS.2008.164.
[30] Nonaka, I. (1994). A dynamic theory of Organization Knowledge Creation, *Organization Science*, 5(1), 14-37. doi: 10.1287/orsc.5.1.14.
[31] Quinn, J. B., Anderson, P., & Finkelstein, S. (1996). Managing professional intellect: Making the most of the best, *Harvard Business Review*, March - April, 71-80.
[32] Schneider, K. (2009). *Experience and knowledge management in software engineering*. Springer-Verlag Berlin Heidelberg. http://doi.org/10.1007/978-3-540-95880-2
[33] Sedighi, M. and Zand, F. (2012). Knowledge Management: Review of the Critical Success Factors and Development of a Conceptual Classification Model, In *10th International Conference on ICT & Knowledge Engineering*, Bangkok, November 2012, pp.1-9.
[34] Senge, P.M. (1990). *The Fifth Discipline: The Art and Practice of The Learning Organization*, Doubleday: New York.
[35] Shih, H.A. & Chiang, Y.H. (2005). Strategy alignment between HRM, KM and corporate development, *International Journal of Manpower*, 26(6), 582-602.
[36] Shirazi, A., Mortazavi, S. & Azad, N. P. (2011). Factors affecting employees' readiness for knowledge management', *European Journal of Economics, Finance and Administrative Sciences*, 33(33), 167-177. Available at: http://profdoc.um.ac.ir/paper-abstract-1023286.html.
[37] Singh, A. and Soltani, E. (2010). Knowledge management practices in Indian information technology companies, *Total Quality Management & Business Excellence*, 21(2), 145-157. doi: 10.1080/14783360903549832.
[38] Sterman, J.D. (2000). *Business dynamics: systems thinking and modelling for a complex world*, New York: Irwin-McGraw-Hill.
[39] Veselovsky, M.Y., Izmailova, M.A., Bogoviz, A.V., Lobova, S.V. and Ragulina, Y.V. (2018). System Approach to achieving New Quality of Corporate Governance in the Context of Innovation Development. *Quality-Access to Success*, 19(163), 30-36.
[40] Wong, K. Y. (2005). Critical success factors for implementing knowledge management in small and medium enterprises, *Industrial Management & Data Systems*, 105(3), 261-279. doi: 10.1108/02635570510590101.
[41] Yang, Y. O., Yeh, J., & Lee, T. (2010). The Critical Success Factors for Knowledge Management Adoption A Review Study, in *Proceedings of the 3rd International Symposium on Knowledge Acquisition and Modeling*, 445-448.
[42] Zeidi, F., & Babaheidari, M. M. (2015). Prioritization of Critical Success Factors in Knowledge-Management Using the AHP Method, *Cumhuriyet Science Journal*, 36. http://doi.org/10.17776/csj.34416
[43] Zieba, M., & Zieba, K. (2014). Knowledge Management Critical Success Factors and the Innovativeness of KIBS Companies, *Inzinerine Ekonomika-Engineering Economics*, 25(4), 458-465. http://doi.org/10.5755/j01.ee.25.4.6494
[44] Zecca, F. & Rastorgueva, N. (2017). Knoweldge management and sustainable agriculture: The Italian case, *Quality-Access to Success*, 18(159), 97-104.