Effectiveness of Knowledge Management in Software Industries – An Empirical Study

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Abstract - The main aim of this study is to analyse the effectiveness of Knowledge Management in Software Industries. The Knowledge Management dimensions which could influence the organizational effectiveness have been identified. Metric to measure the relationship between these Knowledge Management dimensions has been developed. To test the hypotheses, a sample size of 254 software company employees has been collected and Partial Least Square technique of Structural Equation Modelling (SEM) has been used to investigate the empirical relationships between the different identified dimensions. Questionnaires were distributed to 300 employees of different software companies through Google Form. Response rate of 72% (254 employees responded) was achieved in the survey. The testing of hypotheses justified that in terms of organizational effectiveness, the identified dimensions of Knowledge Management are the critical success factors. Implications of the study would enable the Human Resource managers to make their Knowledge Management process more powerful for the enhancement of effectiveness of the organization. It may not be possible to generalize the results for the full extent, as the study limits itself to the number of software industries. All the limitations of statistical testing and modelling and simulation are applicable to this research.

Keywords: Knowledge Management, Software Industries, Employees, Questionnaire, Organizational Effectiveness, Structural Equation Modelling.

I.   INTRODUCTION

Knowledge Management plays an important role in the overall performance of the organization. Knowledge is the most valuable organizational resource which resides in the minds of employees in the organizaiton. The two critical ways of enabling organizational performance are dynamic and active management and implementation of Knowledge [1]. In the current global economy, the software industries have one of the most knowledge intensive organizational setups. For the survival of the industry in the market, they depend on the knowledge and experience of their employees. Since knowledge is the key ingredient of innovation, the knowledge of the people is the largest asset of such organizations [2].

Knowledge Management (KM) was initially defined as the process of applying a systematic approach to the capture, structure, management, and dissemination of knowledge throughout an organization in order to work faster, reuse best practices, and reduce costly rework from project to project [3].

As discussed in the literature, "tacit knowledge" and "explicit knowledge" are the two types of knowledge [4]. Tacit knowledge is difficult to put into words, text, or drawings and also not possible to articulate. Whereas, the content which has been stored in some tangible forms like words, audio, recordings or images are referred as explicit. In other words, tacit knowledge tends to reside "within the heads of knower," whereas explicit knowledge is usually contained within tangible or concrete media [4].

Two major issues which were associated with the new business paradigm were: (i) the knowledge available or to be generated had to be aligned to the business objectives, and (ii) the outcome of the knowledge application had to contribute significantly to the enhancement of business performance.

To implement effective Knowledge Management, the organization should recognise, create, acquire, diffuse and capture the benefits of knowledge that provide strategic benefits to the organization. Knowledge Management processes recognise and locate Knowledge and knowledge sources within the organization. Valuable knowledge is then translated into explicit form, also referred to as codification

of knowledge, in order to facilitate more wide-spread dissemination. Once it is transferred to organizational knowledge repository, it becomes part of organizational memory.

II. LITERATURE REVIEW

As stated by Hurley et al. [5] in their paper, "knowledge – intensive" organizations are those organizations in which most work is of an intellectual nature and in which the well-educated, qualified employees form the major part of the workforce involved. In their paper they have mentioned the accounting firms, software engineering companies, law firms, management consulting firms and research and development companies as examples for knowledge intensive organizations.

Aurum et al. [6] in their book state that Knowledge Management is of high importance in Software Engineering since Software Engineering involves a lot of knowledge work.

King [7] in his book titled, "Knowledge Management and Organizational Learning" states that there is a need for the organization to get explicit Knowledge from the tacit knowledge. The employees should be able to utilize this explicit knowledge as their own knowledge. The employees should be able to create and share additional knowledge from the explicit knowledge they get.

The paper "Arab Academy for Financial and Banking Sciences, Jordan" begins with a brief overview of the Knowledge Management styles [8]. The paper also discusses the outcome of an empirical study which addresses the research questions. This study helps the managers and organizations to define Knowledge Management strategies more clearly. The outcomes presented by this paper show that the deploying of the four Knowledge Management styles are significantly different according to the industry. The literature study clearly shows the necessity of testing the importance and efficiency of Knowledge Management styles in different industries as well as in different countries. In the paper they suggest that it is better to conduct a similar type of research in different countries and different industries for comparing the research results.

Azad et al.[9] have included the six Knowledge Management factors namely Concept of Knowledge, Management, Knowledge Tools, Knowledge Measurement, Change Management, Knowledge Content in their empirical investigation. They reported that Knowledge Content was number one priority followed by Knowledge Tools and Concept of Knowledge Tools and Concept of Knowledge by determining the relationship between entrepreneurship and Knowledge Management components using Structural Equation Modeling.

Davenport & Prusak[10] claim that Knowledge Management can be extended for the management of creating business value and generating a competitive advantage in the organization, Knowledge Management helps in achieving business goals by creating, communicating, and by applying all kinds of knowledge in an organization, Knowledge Management has the ability of creating and retaining greater value from core business competencies. Knowledge Management System enhances the use of information through Knowledge Acquisition, Knowledge Sharing and Knowledge Application for improvement of organization. Thus the captured knowledge can be stored in knowledge repositories and may be shared between individuals and departments in the future.

Aurum et al. [11] in their study used both quantitative and qualitative methods to understand the present practice of Knowledge Management in Software Engineering (SE) processes of two Australian firms. They claimed to implement Knowledge Management practices in their software development work also. They also explain the Knowledge Management activities and Knowledge Management process applied in Software Engineering practice, and examined the enablers of Knowledge Management process for Software Engineering in different terms like new technology, process, leadership, culture, and measurement.

Huang [12] investigated the moderating impact of organizational lifestyle by looking into key knowledge of the user, mind-set and Information Technology with overall performance. Results of the investigation indicated that in an organization having the stronger Information Technology software application, key knowledge of the user would have greater effect on departmental performance than the attitude of the user.

III. OBJECTIVES OF THE RESEARCH

The main aim of this research is to study the Effectiveness of Knowledge Management in Software Industries by analysing the influences of different dimensions of Knowledge Management policies and organisational effectiveness. The following objectives have been developed to accomplish this aim.
1. To identify the dimensions which constitute the effectiveness of Knowledge Management as relevant to the software industries.
2. To develop a metric to measure the dimensions mentioned earlier and to validate it.
3. To develop a hypothetical model linking the various identified dimensions.
4. To obtain empirical evidence for inter-relationships between the identified dimensions.
5. To draw implications and make suggestions to organizations to enhance organizational performance by

implementing knowledge management effectively and efficiently.

IV.   METHODOLOGY

Based on the literature available, the hypothetical model is built to study the influence of Knowledge Management dimensions on organizational effectiveness. As mentioned in the earlier studies, Knowledge Management focuses on building the successful link between knowledge and performance, so it is logical to assume Knowledge Management activities will help to produce valid organizational knowledge and is justified by its ability to perform. It is important to find the influence of different dimensions of Knowledge Management on organizational effectiveness. Based on these the following hypotheses have been developed:

H1. Knowledge management policies have significant influence on organizational effectiveness.
H2. Knowledge Management Processes have significant influence on organizational effectiveness.
H3. Knowledge Sharing has significant influence on organizational effectiveness.
H4. Knowledge strategy has significant influence on organizational effectiveness.
H5. Technology in Knowledge Management has significant influence on organizational effectiveness.
H6. Leadership in Knowledge Management has significant influence on organizational effectiveness.
H7. Training and development has significant influence on organizational effectiveness.
H8. Employee Satisfaction has significant influence on organizational effectiveness.
H9. HR practices have significant influence on organizational effectiveness.

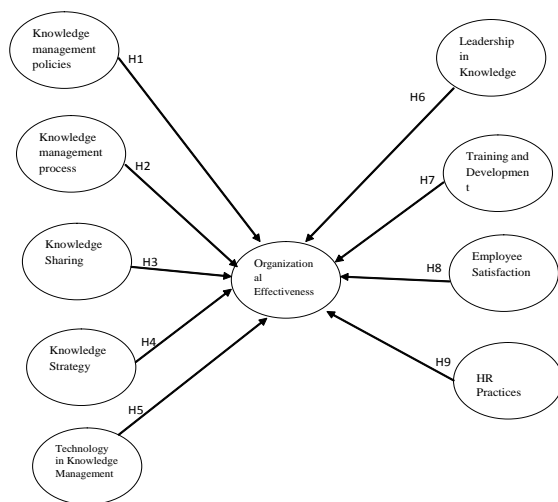The hypothetic research model is depicted in the following figure:

Figure 1 : Hypothetical model

V.   DEVELOPMENT OF QUESTIONNAIRE

Major part of the questionnaire was prepared by studying the literature. While preparing the questionnaire the standard strategy of reachable scales and measurements were considered, specialists in the field were consulted and also the qualified respondents were selected. For measuring the responses a five-point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree was used.

VI.   SAMPLE DESCRIPTION

The questionnaire thus prepared was distributed among the employees of software industries of Karnataka for the study of effectiveness of Knowledge Management in Software Industries,. Questionnaires were distributed through electronic means and also distributed personally to the employees.

For empirically testing the theoretical relationships established through the meta-analysis of literature, statistical analysis is used. The statistical analysis here includes Descriptive Statistics, Mean and Standard Deviation, and Structural Equation Modelling (SEM) using the Partial Least Square Modelling (PLSM). In this research the inferences are drawn based on the results obtained through statistical research and deductive reasoning. The implications and suggestions drawn are substantiated through the secondary source of data.

In this research, effectiveness of Knowledge Management in different software industries has been studied by making use of standard sampling and analytic procedures. The following conceptual diagram shows the different dimensions studied and analyzed:

Figure 2: Conceptual diagram for the study

*Mgt-Management   *Org – Organization
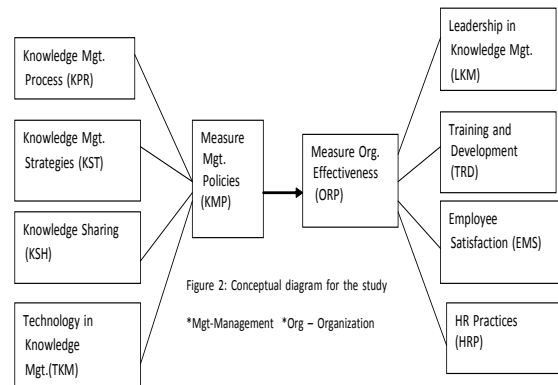
VII.   DATA COLLECTION

For the purpose of collection of data, the Questionnaires were distributed both through electronic and personal modes.iOut of 400 questionnaires distributed, 254 (63.5%)

completed questionnaires were collected after repeated reminders.

VIII. RESULTS AND DISCUSSION

In this study, to test the hypotheses, Partial Least Squares (PLS) is used. Partial Least Squares given is less demanding with regard to the minimum requirements for the sample size and the distribution of variables, compared to co-variance techniques based on Structural Equation Models [13]. In the conditions where the theory is not solidly developed for example when the sample is not very large Partial Least Squares is used. In a systematic and comprehensive analysis, Partial Least Squares examines: (1) the assessment of the measurement models by analyzing the relationships between the latent variables and their indicators; and (2) the assessment of the structural model, examining the relationships between latent variables or constructs [14]

Table 1: Reliability and validity measures of data

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
EMS	0.82	0.829	0.893	0.736
HRP	0.826	0.829	0.885	0.657
KMP	0.782	0.785	0.873	0.697
KPR	0.736	0.742	0.851	0.656
KSH	0.856	0.863	0.912	0.776
KST	0.767	0.786	0.865	0.683
LKM	0.843	0.847	0.905	0.761
TKM	0.828	0.839	0.897	0.745
TRD	0.909	0.91	0.943	0.847

Legend:
Employee Satisfaction (EMS)
HR Practices (HRP)
Knowledge Management Policies (KMP)
Knowledge Management Processes (KPR)
Knowledge Sharing (KSH)
Knowledge Strategy (KST)
Leadership in Knowledge Management (LKM)
Technology in Knowledge Management (TKM)
Training and Development (TRD)

To confirm the dependability of the latent variables in the model- inward consistency reliability measure, item reliability measure and composite reliability measures were determined. Cronbach''s alpha coefficient and the composite reliability result for the final model is shown in Table 1. The alpha coefficient has the acceptable value ranging from 0.7 to 0.95, indicating a moderate to high level of internal consistency. The composite reliability estimate also ranges from 0.8 to 0.95 indicating moderate to high reliability values. The results of the convergent validity assessed based on factor loading (> 0.7) indicate a strong effect of the factor on the variable of study (Table 2). To test for discriminant validity, the square root of average variance extracted (AVE)

for each construct was compared with the correlation between the construct and the other constructs. Table 3 shows acceptable discriminant validity between each pair of construct, with all AVE square roots greater than the correlation between the constructs.

Table 2 Factor loading after Reduction

	EMS	HRP	KMP	KPR	KSH	KST	LKM	TKM	TRD
EMS2	0.79								
EMS4	0.903								
EMS5	0.877								
HRP3		0.833							
HRP4		0.839							
HRP6		0.812							
HRP7		0.757							
KMP3			0.801						
KMP4			0.855						
KMP5			0.847						
KPR1				0.823					
KPR2				0.851					
KPR4				0.751					
KSH5					0.891				
KSH7					0.9				
KSH9					0.851				
KST3						0.848			
KST4						0.87			
KST5						0.756			
LKM3							0.847		
LKM6							0.86		
LKM7							0.91		
TKM6								0.893	
TKM7								0.896	
TKM8								0.797	
TRD1									0.938
TRD2									0.937
TRD3									0.884

Table 3 : Inter Item Correlation

	EMS	HRP	KMP	KPR	KSH	KST	LKM	TKM	TRD
EMS	0.858								
HRP	0.567	0.811							
KMP	0.509	0.663	0.835						
KPR	0.431	0.64	0.574	0.81					
KSH	0.585	0.619	0.617	0.641	0.881				
KST	0.435	0.584	0.616	0.651	0.611	0.826			
LKM	0.601	0.507	0.585	0.486	0.725	0.584	0.873		
TKM	0.611	0.501	0.548	0.457	0.711	0.481	0.791	0.863	
TRD	0.453	0.523	0.616	0.484	0.561	0.507	0.672	0.649	0.92

The inter-relationship between the endogenous and exogenous variables of this study is given by Structural Model of the SEM. This relationship is used for the hypothesis testing at the micro level of the latent variables. The factor loadings after reduction, path coefficients, and R2 are shown in Table 1 and the t-values are shown in Table 4. For all the relationships established, the path coefficient values ranged from 0.03 to 0.6 and the R2 values were up to 0.9 which is quite adequate in comparison to the other research studies in this field as cut off is 0.1[15].The SEM indicated that the following hypotheses were supported:
H1. Knowledge Management Policies (KMP) have significant influence on organizational effectiveness.
H2. Knowledge Management Processes (KPR) have significant influence on organizational effectiveness.
H3. Knowledge Sharing (KSH) has significant influence on organizational effectiveness.
H4. Knowledge Strategy (KST) has significant influence on organizational effectiveness.

H7. Training and Development (TRD) has significant influence on organizational effectiveness.

Table 4: t-statistic of Hypothetical Research Model

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values	Hypothesis
KMP -> EMS	0.157	0.153	0.07	2.235	0.026	Supported
KMP -> HRP	0.335	0.329	0.082	4.065	0.001	Supported
KMP -> LKM	0.078	0.082	0.055	1.407	0.16	
KMP -> TRD	0.305	0.304	0.065	4.688	0.004	Supported
KPR -> EMS	0.038	0.032	0.078	0.482	0.63	
KPR -> HRP	0.274	0.273	0.07	3.936	0.002	Supported
KPR -> LKM	-0.071	-0.07	0.05	1.409	0.159	
KPR -> TRD	0.084	0.087	0.073	1.148	0.251	
KSH -> EMS	0.197	0.211	0.104	1.892	0.059	
KSH -> HRP	0.157	0.162	0.093	1.682	0.093	
KSH -> LKM	0.237	0.235	0.073	3.266	0.001	Supported
KSH -> TRD	-0.037	-0.04	0.098	0.374	0.708	
KST-> EMS	0.022	0.025	0.077	0.282	0.778	
KST-> HRP	0.085	0.088	0.084	1.009	0.313	
KST-> LKM	0.186	0.188	0.062	2.977	0.003	Supported
KST-> TRD	0.08	0.079	0.079	1.007	0.314	
TKM -> EMS	0.357	0.35	0.091	3.931	0.003	Supported
TKM -> HRP	0.04	0.039	0.076	0.518	0.605	
TKM -> LKM	0.523	0.52	0.07	7.477	0.001	Supported
TKM -> TRD	0.432	0.432	0.099	4.378	0.006	Supported

IX.   Findings and Implications for Strategic Managers

Knowledge Management has significant influence on effectiveness of organizations. Hence, one of the most important implications to the managers of knowledge intensive service organizations is that organizational performance can be achieved by strengthening the Knowledge Management processes It is a general observation that KM processes heavily rely on Knowledge Sharing, Training and Development, Technology in Knowledge Management and Knowledge Strategies

particularly the Information Technology (IT). It is also necessary to have a strong work culture, trust and transparency in all areas of the organization to enhance Knowledge Management processes to be effectively supported by the knowledge workers.

X.   Conclusion

The primary forms of this study was to understand the effectiveness of Knowledge Management in Software Industries through the influence of the dimensions of KM processes: Knowledge Management Policies, Knowledge Management Processes, Knowledge Sharing, Knowledge strategy, Technology in Knowledge Management, Leadership in Knowledge Management, Training and development, Employee Satisfaction, HR practices**.** What was revealed through hypothesis testing was that only the dimensions such as - KMP -> EMS, KMP -> HRP, KMP -> TRD, KPR -> HRP, KSH -> LKM, KST -> LKM, TKM -> EMS, TKM -> LKM, TKM -> TRD of KMP had a significant influence on organizational effectiveness. These revelations could lead to the development of the strategic implications for the managers of knowledge intensive service industries to enhance their organizational performance. There are a few limitations which provide scope for future research - this is mainly a quantitative analysis and all the limitations of the second generation statistical analysis are applicable to this research. Sample size has always been an issue in empirical studies and in this research, even though the standard formula has been adopted, the assumptions in the formula act as the limitation for the possibility of generalization of the results completely. Finally, this being a perception based study it has its own methodological limitations. Future researchers may consider the possibility of studying the combined influence of knowledge management as well as total quality management as the mediating variable.

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