DETERMINANTS OF SUCCESSFUL KNOWLEDGE MANAGEMENT IN SOFTWARE DEVELOPMENT INDUSTRY IN SRI LANKA

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INTRODUCTION

The process of software development requires a high amount of knowledge to carry out knowledge-intensive development activities such as requirement gathering, analysing of problems, designing of solutions, implementing the solution via coding and testing the end product to ensure a quality, bug-free software product. Hence, software teams are required to have strong knowledge on software development methodologies, technologies, and project management processes to make their projects successful (Ryan & O'Connor, 2013).

Software companies in worldwide face issues such as continuous rework, increased development time and decreased productivity which lead to failed projects due to inefficient and ineffective knowledge management (Ahmed, et al., 2017). Therefore, it is crucial for software firms to pay attention on preserving and managing knowledge in the right way to avoid rework and increase productivity.

This can be achieved by having a proper knowledge management system in place to preserve and manage knowledge. Knowledge management can be defined as use of information and communication technology to manage the work of the employees of the organization, or the establishment of a corporate culture focusing on promoting social processes shared between individuals, aiming to achieve a sustainable source of advantages (Ouriques, et al., 2019). It can be applied in the distinct phases of software process as requirements identification, software testing, evolution, maintenance, and architecture (Chugh, et al., 2019). To implement an effective knowledge management system, it is important to recognize the factors leading towards it.

There are a number of studies that have been carried out in the past to identify the factors affecting a successful knowledge management system in various industries. Previous literatures suggest organizational culture, leadership, technological framework, and knowledge management measurements as some of the key factors which make a direct impact on an organizational knowledge management system (Aurum, et al., 2008; Noor, et al., 2014; Shahidifar, 2016; Hijazeen, et al., 2018).

METHODOLOGY

A conceptual framework was developed, and hypotheses were formulated based on the literature review. The objective of the study was to analyse significant factors which determine a successful knowledge management system in software industry. Hence, the conceptual framework was consisted of Effective knowledge management system as the dependent variable and Leadership, Organizational Culture, Technology and Knowledge Management Measurements as independent variables. Independent variables were derived from the findings of past literature which stated that they directly influence an organizational knowledge management system (Aurum, et al., 2008; Noor, et al., 2014; Shahidifar, 2016; Hijazeen, et al., 2018). Furthermore, the following dimensions of each variable were identified as indicators from previous literature to help measure changes in concepts.

Dimensions for Effective Knowledge Management are Acquisition/Creation of knowledge (Ouriques, et al., 2019), Storage/Retrieval of knowledge (Ouriques, et al., 2019), Transfer of knowledge (Ouriques, et al., 2019) and Application of knowledge (Ouriques, et al., 2019)

Leadership is measured by rewarding (Team, 2020) and Top Management Support.

Organizational Culture has dimensions of Time, Structure and Openness (Mueller, 2014)

Dimensions for Technology are IT Knowledge (López, et al., 2009), IT Operations (López, et al., 2009) and IT Infrastructure (López, et al., 2009)

Knowledge Management Measurements have dimensions of Knowledge Management Champions (Aurum, et al., 2008), Performance Reviews, Retrospectives and Standards and Guidelines

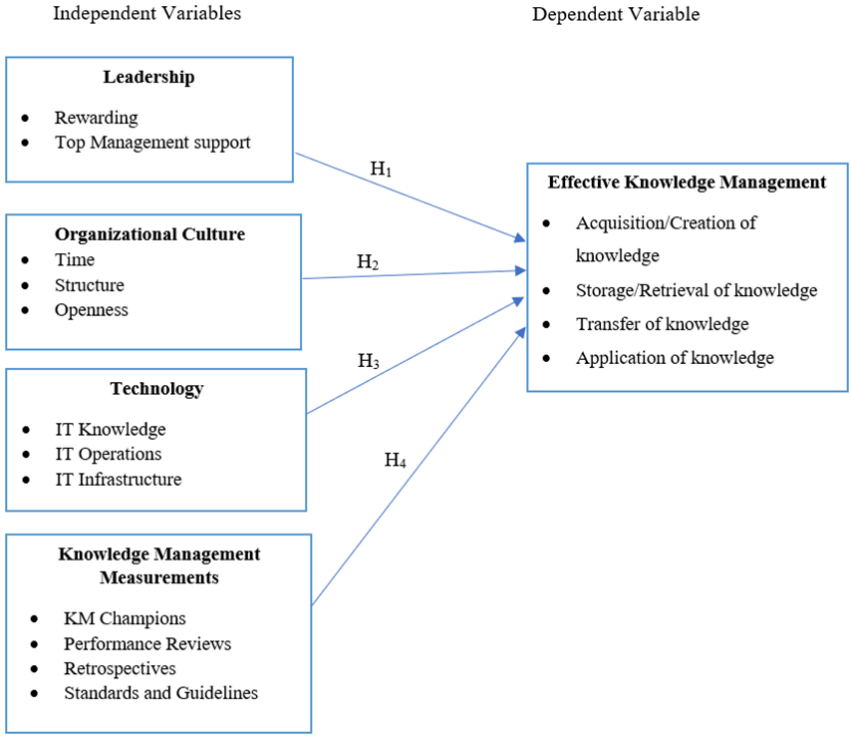

Figure 1: Conceptual framework
Source: *Developed by researcher*

Following hypotheses were set to be assessed under this study based on the above theoretical framework.

Leadership
$H1_a$: There is a significant relationship between leadership and effective knowledge management in software development organizations
$H1_0$: There is no significant relationship between leadership and effective knowledge management in software development organizations

Organizational Culture

$H2_a$: There is a significant relationship between organizational culture and effective knowledge management in software development organizations
$H2_0$: There is no significant relationship between organizational culture and effective knowledge management in software development organizations

Technology
$H3_a$: There is a significant relationship between technology and effective knowledge management in software development organizations
$H3_0$: There is no significant relationship between technology and effective knowledge management in software development organizations

Knowledge Management Measurements
$H4_a$: There is a significant relationship between knowledge management measurements and effective knowledge management in software development organizations
$H4_0$: There is no significant relationship between knowledge management measurements and effective knowledge management in software development organizations

An online questionnaire survey that has been developed using google forms, was used for collecting the data and the survey instrument was developed based on the previous measurements from literature review (Donate & Sánchez de Pablo, 2015), (Mueller, 2014), (López, et al., 2009), (Mehta, et al., 2014).

A five-point Likert scale was employed for measuring the extent of agreement or disagreement on each item, where 1 represented "strongly disagree" and 5 represented "strongly agree". According to the Krejcie and Morgan table, the sample size was calculated as 217 for a population of 510 with 95% confidence level and 5% marginal error (Krejcie & Morgan, 1970). A pilot survey with 27 employees in software industry was conducted to reduce the possible unclear statements in the questionnaire. A total of 271 questionnaires were distributed to the employees via email who were engaged in the software development industry and collected 163 valid responses, which was over 60% of initially decided sample size.

RESULTS AND DISCUSSION

The questionnaire was initially distributed among 27 people in the organization to conduct the pilot test and the Cronbach's Alpha value came out as 0.836 which is above the acceptable value of 0.7. This showed that the validity and reliability of the questionnaire was high and data gathering can be progressed. Kaiser-Meyer-Olkin (KMO) value was as 0.814, which indicated that the sampling was adequate. Only Cronbach's Alpha and KMO values were calculated for the pilot test.

For the main analysis Cronbach Alpha value was calculated again for the whole sample of 163 and the new value was 0.806, thus proving that the survey carried out was reliable. KMO and Bartlett's test was used to measure the sampling adequacy. The value reported up to 0.740, which was close to acceptable range of 0.8 and 1.

Below table illustrates the Pearson correlation matrix generated for variables. Significance is also included under correlation value.

		Effective Knowledge Management	Leadership	Culture	Technology	KM Measurements
Effective Knowledge Management	Correlation and Significance	1	.594** .000	.735** .000	.488** .000	.527* .001*
Leadership	Correlation and Significance	.594** .000	1	.545** .000	.314** .002	.612** .000
Organizational Culture	Correlation and Significance	.735** .000	.545** .000	1	.464** .003	.505** .000
Technology	Correlation and Significance	.488** .000	.314** .002	.464** .003	1	.240** .000
KM Measurements	Correlation and Significance	.527** .001	.612** .000	.505** .000	.240** .000	1

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

Table 1: Correlation Analysis
Source: *Data analysis by SPSS*

According to the above correlation matrix table, it is visible that all independent variables; leadership, culture, technology, and KM measurements are positively correlated to effective knowledge management with values of 0.594, 0.735, 0.488 and 0.527 respectively.

The correlation between organizational culture and effective knowledge management is the strongest, while the correlation between technology and effective knowledge management is the weakest.

Below table illustrates the model summary of regression analysis consisting of all four independent variables.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.942[a]	.887	.885	.14659	.887	311.538	4	158	.000	2.046

a. Predictors: (Constant), KM Measurements, Technology, Leadership, Culture

b. Dependent Variable: Effective Knowledge Management

Table 2: Model summary of Regression analysis
Source: *Data analysis by SPSS*

In this result set, Durbin-Watson value is 2.046, which is almost 2. Hence, it can be concluded that errors are independent, and regression could be run for the dataset and no autocorrelation for dataset detected. R Square(R^2) is equal to 0.887, which indicates that 88.7% of the variation in effective knowledge management can be explained by leadership, culture, technology, and KM measurements.

Coefficient table can be used to describe the mathematical relationship between each independent variable and dependent variable and derive the regression equation out of the results.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		VIF
		B	Std. Error	Beta			Lower Bound	Upper Bound	
1	(Constant)	.370	.136		2.725	.007	.102	.637	
	Leadership	.049	.017	.103	2.847	.005	.015	.084	1.828
	Culture	.769	.032	.837	23.672	.000	.705	.833	1.757
	Technology	.080	.040	.061	2.014	.046	.002	.159	1.284
	KM Measurements	.016	.021	.026	.752	.453	-.026	.057	1.715

a. Dependent Variable: Effective Knowledge Management

Table 3: Coefficient table
Source: *Data analysis by SPSS*

Leadership records a B value of 0.049(p=0.005, less than 0.05), which implies that leadership is a significant predictor for effective knowledge management. Culture has a B value of 0.769(p=0.000, less than 0.05) which also means that culture can be considered as a significant predictor of effective knowledge management. B value for technology is 0.080(p=0.046, less than 0.05). Hence, Technology is a significant predictor of effective knowledge management. KM measurements has a B value of 0.016(p=0.453, greater than 0.05). Therefore, KM measurements cannot be considered as a significant predictor of effective knowledge management.

Regression equation can be expressed as below according to the above analysis.

Y=0.370+ 0.049 Leadership +0.769 Culture+0.08 Technology

The constant value for the model is recorded as 0.370, which denotes that effective knowledge management would stand at 0.370 units when all four independent variables are set as zero.
If one unit increases in leadership factor, there is an increment of .049 in effective knowledge management. When a single unit is increased in culture, effective knowledge management is increased by 0.769. A unit change in Technology could be explained by .080-unit change in effective knowledge management when the other factors are held constant.

Based on regression analysis results, summary of hypotheses can be discussed as below.

Table 4: Summary of Hypotheses

	Hypothesis	B value	Accepted/Rejected
Leadership	There is a significant relationship between leadership and effective knowledge management in software development organizations	0.049 (p=0.005)	Accepted
Organizational Culture	There is a significant relationship between organizational culture and effective knowledge management in software development organizations	0.079 (p=0.000)	Accepted
Technology	There is a significant relationship between technology and effective knowledge management in software development organizations	0.080 (p=0.046)	Accepted
KM Measurements	There is no significant relationship between knowledge management measurements and effective knowledge management in software development organizations	0.016 (p=0.453)	Accepted

Source: *Developed by researcher*

Based on analysis results, this study supports several findings stated in previous literature. A study done in 2014 by Noor, et al revealed that organizational culture, structure, and IT related factors such as information system, technical infrastructure and usage of social media affect positively on knowledge sharing within organizations. Studies done by Hijazeen, et al (2018) and Probodha and Vasanthapriyan (2019) both stated that cultural attributes, leadership styles and information technology infrastructure enable successful knowledge sharing in organizations. Even though Aurum, et al (2008) claimed that knowledge management measurements is an enabler for successful knowledge management, this study argues that it doesn't make a significant impact on knowledge management

CONCLUSIONS/RECOMMENDATIONS

Based on the data analysis results, following conclusions could be drawn as solutions to the research problem.

Correlation analysis shows that all four independent variables, Leadership, Culture, Technology and Knowledge Management Measurements are positively correlated with effective knowledge management. Organizational Culture has the strongest correlation with effective knowledge management, which concludes that, to sustain effective knowledge management of the company, all four dimensions needs to be addressed, while focusing more on cultural attributes of the organization.

Results from multiple regression analysis indicate that Organizational Culture has the strongest contribution to organization's effective knowledge management with a B value of 0.769(p=0.000). Furthermore, Leadership and Technology also positively contribute to the effectiveness of knowledge management of an organization with B values of 0.049(p=0.005) and 0.089(p=0.046) respectively. Knowledge Management Measurements was not identified as a significant variable contributing to the dependent variable as its B value was 0.016(p=0.453, which is greater than 0.05).

This study statistically proves that out of all four variables, only Leadership, Organizational Culture and Technology are significant in building an effective knowledge management system while Knowledge Management Measurements is insignificant, even though it was identified as a significant dimension by past scholars.

Therefore, it is recommended that relevant strategic decisions should be taken to make changes in leadership styles, organizational culture elements and technology infrastructure to promote effective knowledge management within the organization.

Changes to Organizational Culture

Existing organizational structure needs to be transformed to support knowledge culture. To build up a knowledge culture, exclusive knowledge management job roles such as Chief Knowledge Officer, Knowledge Managers and Knowledge Analysts should be introduced, a comprehensive hierarchy for knowledge management should be setup and knowledge management roles should be embeded into day to day job of employees. For an example, employees with positive attitudes and correct skills towards knowledge management can be awarded with knowledge management responsibilities along with their respective job description. A dedicated time should be set for employees to learn, collaborate, create, and share knowledge during the work time.

Changes to Leadership Behaviors

Positive leadership activities such as empowering subordinates, allocating required resources, allowing change and experimentation, having trust in employees, having room for errors /mistakes and establishing long term perspective among employees about organizational goals and how knowledge management make an effect on them, can be promoted to influence knowledge management within the organization.

Identifying correct knowledge management activities done by employees and rewarding them accordingly is also an action point for the organization to be focused on. Rewarding can be direct, such as monetary incentives or indirect, such as recognition and appreciation. It is important to have a standardized procedure in developing reward system for promoting knowledge management in the organization.

Knowledge management evangelization should also be practiced by the senior leadership of the organization. Senior managers can actively participate in the process of evangelization and make sure that knowledge management is highly valued in the organization and knowledge management programs are designed and executed correctly. Middle and front-end managers should also be informed with necessary information and programs initiated by senior managers as front and middle managers determine the success of knowledge management programs in each team.

Changes to Technological Infrastructure

Technological infrastructure should be enhanced to facilitate effective knowledge management of the organization. An enterprise knowledge portal can be established within the organization to act as a platform for information sharing and communication. It can be treated as a central source of organizational knowledge base which allows knowledge sharing within organization as well as external parties such as customers and partners. To act as a single gateway for organization's knowledge base, a knowledge portal would be consisted of components such as content management systems, groupware, search engines, video conferencing tools, decision support systems and AI tools. Data warehousing, data mining and analysis tools can be integrated with the knowledge portal to provide a seamless flow of communication, collaboration, information sharing, learning and decision-making based on past knowledge.

This research covers only 88.7% (R^2) variance of the factors which affect successful knowledge management practices of software organizations in Sri Lanka. Future researches can focus on identifying the rest of the factors and assessing their impact with more dimensions. The same study can be carried out based on a longitudinal approach where the data collection can be done over a long period of time repeatedly rather than collecting data within a short period of time

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