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Linking The Customer Knowledge Management with Software Quality: An Empirical Study of Software Development Organizations in Pakistan

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ABSTRACT

The research aimed to enhance Customer Knowledge Management (CKM) which has a high impact on the quality of software products. In Enterprise Software (ES) development the Customer knowledge management is still immature. This raises the question of how CKM enablers can be used to help ES development companies improve the quality of software. The results of the study showed that CKM enablers can help to improve the quality of software products in Pakistan. Framework for CKM can help software development organizations to improve software quality as well and will also reduce cost and gain market reputation with competent trained resources. Results showed that "customer involvement" with "trust" was the most influential factor, followed by "CRM technology infrastructure" and "cross-functional co-operation". Furthermore, "there was no impact from the organizational Training", "customer knowledge map", and "CKM strategy development". The impact of CKM on software quality is significant. The results of the study also highlighted all the potential factors that are beneficial in influencing the CKM for quality improvement of ES in Pakistan.



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Introduction

With the increase in the negotiation power of consumers and the emergence of the information economy, the approach of doing business and managing customer markets in organizations has modified considerably. The knowledge about the customers and its management in organizations are getting important to sustain business in the future. Al-Shammari (2009) emphasizes that Customer Knowledge Management (CKM) allows organizations to create distinctive core competencies by attaining information related to customers. CKM has attained extensive popularity within the past decade and is stated in each enterprise and educational field (Gibbert et al., 2002; Su et al., 2006; Chen and Su, 2006; Deloitte, 2012; Mukherji, 2012; Wilde, 2011; Kankanhalli and Lee, 2011; Paquette, 2008;). The literature has emphasized the necessity for the

universal view of clients in organizations (Smalley, 2000; Greenberg, 2009; Pockard, 2009; Deloitte, 2012; Shannak et al., 2012). However, there may be an enormous lack of literature concerning the way to attain customer knowledge (Salomann et al., 2005; Zanjani et al., 2008; Pockard, 2009; Liautaud, 2010).

Customer Knowledge Management (CKM) is rapidly becoming a significant factor for the competitiveness of an organization. As a result, more and more research is being conducted in this field (Wang, 2015). Optimal CKM benefits an organization in terms of Services/Products quality enhancement while decreasing the Service/Production costs. However, concerning organizations in Pakistan, it is easier said than done. There are various challenges faced by an organization seeking to fully implement CKM. Specifically, there exists a research gap on the effectiveness and direction of deploying certain Human, Technological, and Organization level factors for the management of customer knowledge to meet customer requirements (Korhonen et al., 2016). Customer-centric processes along with customer knowledge management are being recognized by practitioners and analysts as very important for organizations to sustain in progressively competitive international markets (Gibbert, 2002; Stefanou et al., 2003; Al-Shammari 2009; Deloitte, 2012). CKM encompasses 'knowledge for customers', 'knowledge about customers', and 'knowledge from customers.'

Practicing CKM efficiently and effectively has major implications for organizations. Rollins and Halinen (2005) suggest that CKM competency ought to involve the subsequent 5 areas:

1. Inter-functional cooperation
2. adjunct organizational systems
3. cooperation with customers
4. adjunct IT systems
5. organizational culture that supports learning and client orientation.

Research conducted in the area of Software Quality Enhancement indicates that they are mostly focused on functional and non-functional aspects of software products as quality measures (Cho et al., 2013). Therefore, there is Customer Knowledge Management research needed in Software Development Organizations of Pakistan. According to (Association for Project Management, 2006) it can be unanimously declared that customers are vital among all the stakeholders of a project. And it is plausible that customer satisfaction and resultantly project success can be increased manifold if customer interaction in terms of collaboration and communication is increased in any Software Development Life Cycle (SDLC).

There are a lot of organizational challenges involved in the process of implementing and practicing CKM. Smith and McKenn (2005) found challenges of organizations that can be structural, cultural, and related to competencies, and as per Desouza and Awazu (2005), these are of integration, segmentation, distribution, and application. There is significant work published emphasizing CKM (Salomann et al, 2005; Zanjani et al, 2008; Pockard, 2009; Liautaud, 2010). Customer Knowledge Management can also be utilized to get development phase-wise feedback from customers and then application of this feedback for further process improvement. Since there is a lack of CKM integration in Software Development for quality improvement and developed framework to use CKM in this industry is not available. Further exploration is also required to check the impact of CKM utilization specifically for Software Quality improvement (Zhang, 2011).

The current research aims to enhance Customer Knowledge Management (CKM) which has a high impact on the quality of software products. In Enterprise Software (ES) development the Customer knowledge management is still immature, the research aims at how the CKM enablers can help to improve the quality of software products in Pakistan.

Research Objectives

The objectives of the study are as follows:

1. To identify the factors that have an impact on Customer Knowledge management (considering Technological, Organizational, and Human) in software organizations.
2. To focus on ranking all the possible factors that can be beneficial in influencing the Customer Knowledge Management for quality improvement of Enterprise Software in Pakistan.

Literature Review

Customer Knowledge (CK) is the mixture of perception, experience, and value that is gained during the interaction between Customer and Organizations (Gebert et al., 2002). However, Customer Knowledge Management (CKM) refers to gaining, sharing, and utilizing CK for the benefit of not only customers but also the organization. Whereas knowledge is perceived in two distinct ways by Rationalism and Empiricism (Nonaka & Takeuchi 1995; Kandadi, 2006). Management is a process of planning, organizing, controlling processes to achieve goals (Daft, 2010; Schermerhorn, 2005). This study follows the definition “Management is defined as the accomplishment of organizational goals effectively and efficiently through planning, organizing, leading and controlling organizational resources” by Daft, 2010.

The scope of customer information contains not only 'customer information' and 'customer information but also 'customer information' (Salomann, et al., 2005; Zanjani et al, 2008; Akhavan & Heidari, 2008). Al-Shammari (2009) underscored a new division that is a combination of information and customers. Gibbert et al. (2002) emphasize the importance of the customer as a source of new product development and also emphasize the term 'prosumer' (customer as a producer and consumer). With the onset of the information economy, the emphasis has shifted from land, labor, and the head of knowledge. Information economics is based directly on the use of information and knowledge (OECD 1996). Information is not only an important asset to organizations but also explains what is important for growth. Within the economic challenges that underpin knowledge lies in the production of information that falls within the scope of Knowledge Management (Beijersy, 1999). Information Management as a discipline has attained much popularity over the past two decades.

CKM is advantageous to both organizations and clients (Davenport et al, 2001; Gibbert et al, 2002; Garcia-Murillo and Annabi, 2002). Effective CKM will allow organizations to create existing products and expand products/ services. Effective CKM will allow you to capture customer purchasing behavior and highlight features that perform a crucial role in customer decision-making. CKM focuses on customer satisfaction which subsequently promotes customer loyalty.

Knowledge-Based View Theory (KBV)

Knowledge management plays a very important role on which the success of an organization depends. In Knowledge management, information has been identified, stored, collected, and shared with individuals within an organization. (Noel Ransom) Knowledge-based view theory of firm performance attracts the attention of many scholars in the arena of economics, organizational theory, and strategic management in the last decade. In 2007, Lin presented a knowledge management framework that supports Knowledge-Based View (KBV) theory. According to KBV, the performance of firms depends upon their members who improve the organization's knowledge area and implement it to produce high-quality products and services (Grant, 1996). Framework enablers are categorized into three factors: Human, Organizational, and Technology. These are used to develop individual, technological, and organizational capabilities to enable effective KM in the firms. The Processes are used to collect, share, apply experiences and expertise in the organization. The outcomes are used to achieve the organization's performance and product

quality. This study is about Automation Software Testing (AST) implementation by using KBV which undertakes that knowledge is maintained by individuals, not by organizations (Grant, 1996).

CKM Framework

The generic Knowledge Management framework involves 3 basic features: Enablers, Processes, and Outcomes. The Enablers can be further categorized into Human, Organizational, and Technology (Lin et al., 2007). Where the role of enablers is to facilitate KM (Knowledge Management) in the organization by developing and improving the capabilities of personnel, organization, and technology (Lin et al., 2007). The processes about the collection of customers’ knowledge, sharing, and application of knowledge gained within the organization. And the results will depict the level of KM effectiveness in organization performance.

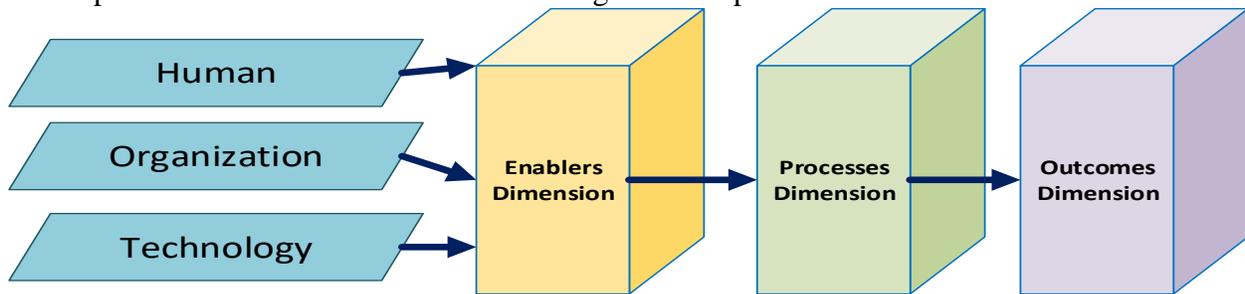


Figure 1: The Generic Framework of Customer Knowledge Management Processes

Customer Knowledge Management enablers are the critical aspects to activate CKM, by removing hurdles of CKM, and providing Organizational, Human, and technical support to ease CKM implementation (Khosravi et al., 2014). In 2010, a study categorizes the Customer Knowledge Management process into four major Phases. In the first phase, Customer Knowledge is acquired, in the second phase CK is stored in the system, in the third phase the Acquired and stored CK is shared among others and finally, in the fourth and last phase, this knowledge is utilized by the application. The desired outcomes of CKM are improved Products/Services quality and hence the organization’s efficiency (Hammami et al., 2011). This refers to the capability of an organization to better understand a customer’s needs and requirements and improve its performance to gain customer satisfaction. Here it can be inferred that quality of product/service is the main desired CKM outcome. However, in software development organizations, the consequence of CKM on product quality is not much explored and researched.

Hypothesis Development

Based on the aspects that affect CKM and Software Quality rapport (Khosravi et al., 2017), research is conducted on 10 hypotheses as mentioned below:

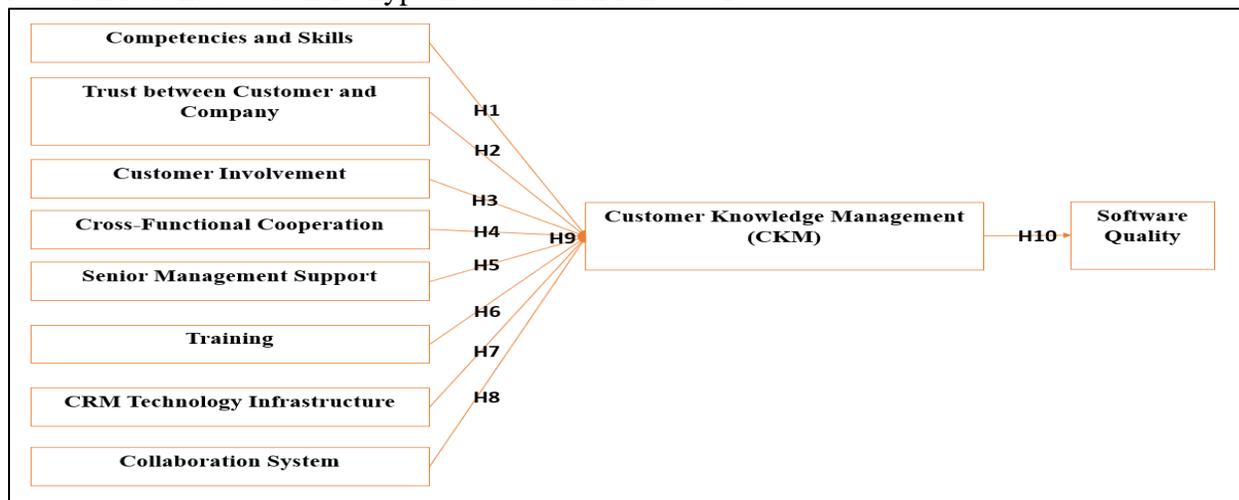


Figure 2: Research Model

Hypothesis 1: There is a positive and significant relationship between Personnel skills and capability and CKM in Software Development Organizations.

Hypothesis 2: There is a positive and significant relationship between Customer-Company trust and CKM in Software Development Organizations.

Hypothesis 3: There is a positive and significant relationship between Customer Participation and CKM in Software Development Organizations.

Hypothesis 4: There is a positive and significant relationship between Customer-focused culture and CKM in Software Development Organizations.

Hypothesis 5: There is a positive and significant relationship between Senior Management Willingness and Support and CKM in Software Development Organizations.

Hypothesis 6: There is a positive and significant relationship between Employee Training and CKM in Software Development Organizations.

Hypothesis 7: There is a positive and significant relationship between Customer Relationship Management technology and CKM in Software Development Organizations.

Hypothesis 8: There is a positive and significant relationship between Collaboration Systems and CKM in Software Development Organizations.

Hypothesis 9: There is a positive and significant relationship between Organizational Knowledge Flow and CKM in Software Development Organizations.

Hypothesis 10: There is a positive and significant relationship between CKM and Software Quality in Software Development Organizations of Pakistan.

Research Methodology

Based on the CKM literature, the research model is developed.

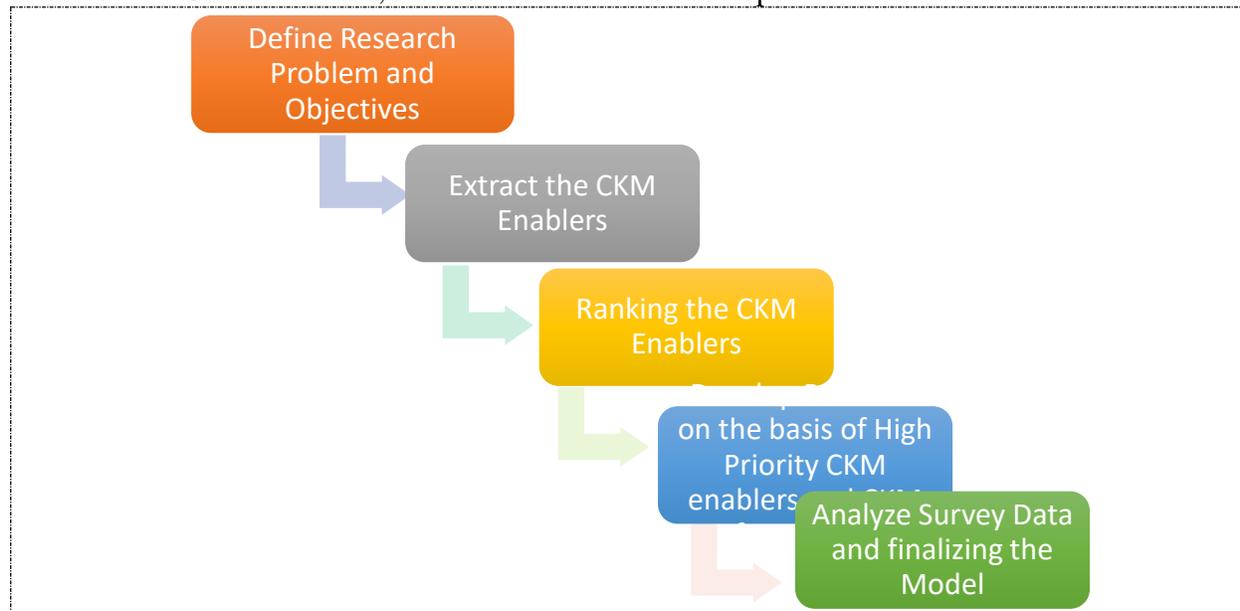


Figure 3: Research Design Framework

The research study follows quantitative choice. In a quantitative study, the analysis is made based on survey results. The study collects primary data from 270 respondents through a self-administered questionnaire distributed in Software Development Organizations, as the emphasis of the research is to enhance the software quality through CKM. The respondents in this study are the persons working in software organizations either at the Senior Management level, in Quality Department, or who deal with Customer Requirements. In this research study, we use convenience sampling which lies in the non-probability sampling technique. After collecting the data, we use SPSS and Smart PLS for data analysis. We use PLS-SEM for the data analysis. PLS-SEM suggests

considerable potential for examining large datasets, including secondary data that often do not include full marking on the wealth of measurement theory (Hair, Sarstedt, & Ringle, 2019).

Data Analysis

The present study collects data from the software companies of Pakistan. The respondents are those who involve in handling customer inquiries, software developers, engineers, team leads, and are highly informed about the CKM and quality. Maximum outreach to employees of the companies was done by sending the google survey form via email. The respondents were asked thirty-eight questions and the questionnaire was divided into eleven parts. Five out of thirty-eight questions are about the demographics of the respondents. Thirty-three out of thirty-eight (86 %) questions are valid with the analysis of CKM. For the data collection phase, companies HR and administration sections are contacted who are registered with the software technology board.

The data analysis was done as suggested by Hair et al. (2013). The two phases proposed are an examination of the measurement model regarding the validity, reliability, and a structural model. The overall reliability and Cronbach's alpha values are above 0.7. In addition, all AVE values are above the limit of 0.5, which shows that there are no tolerance issues. Table 1 includes (1) path coefficients (2) the corresponding t-values of the paths (3) the p-values. The PLS approach, used in this study, is consistent with previous studies (Lin et al., 2012).

Table 1: Model Summary

Hypothesis	Path Coefficient	t-value	p-Value	Results
H1	0.14261	2.650352	0.018649	Supported
H2	0.171132	2.443019	0.029619	Supported
H3	0.198557	2.984937	0.007679	Supported
H4	0.123961	2.767731	0.014261	Supported
H5	0.110797	2.893886	0.009873	Supported
H6	0.161259	2.399139	0.03291	Supported
H7	0.166744	2.576853	0.02194	Supported
H8	0.157968	2.730433	0.015358	Supported
H9	0.690013	12.60014	0.014	Supported
H10	0.176901	2.631855	0.036102	Supported

The research has increased over the years related to CKM that also indicates its importance in companies and professional organizations. Although a lot of research is underway in CKM still gap was identified in the CKM enablers. Considerable data was selected from the publications between the period 2010-2020 where antecedent factors were obtained. It was noted that all the articles published used the survey method to conduct research. The results showed that the antecedent factors are mostly customer-centric culture while the highest frequency in literature was seen for "Organizational Culture" and the least frequency was observed for "Trust between Customer and Company". The frequency table is listed below.

Table 2: The CKM Frequencies

CKM Antecedent Factors	Frequency
Collaboration System	29
Competencies and Skills	25
CRM Technology Infrastructure	29
Cross-Functional Cooperation	14

Customer Involvement	12
Customer Knowledge Management (CKM)	28
Organizational Culture	38
Senior Management Support	18
Software Quality	20
Training	17
Trust between Customer and Company	5

Ranking CKM for quality improvement was also a key objective of the study. The study took guidance from the published work of (Khosravi et al. 2017) where he developed a theoretical model for CKM based on twenty-two antecedent factors of CKM. These factors were extracted from the literature in his study. Based on the assumptions of this model and the addition of newly published research from literature, ranking on CKM antecedent factors was made using the same guidelines and are depicted in Table No. 3.

Table 3: Ranking of CKM Antecedent Factors

Factors	Ranking
Collaboration System	0.79
Senior Management Support	0.68
Organizational Culture	0.36
CRM Technology Infrastructure	0.22
Customer Knowledge Management (CKM)	0.19
Training	0.64
Competencies and Skills	0.50
Customer Involvement	0.42
Cross-Functional Cooperation	0.37
Software Quality	0.19
Trust between Customer and Company	0.06

Human Factors that include two sub-factors i.e., Competencies and Skills & ii) Trust was analyzed. Among the respondents, 43 % agreed that human factors are important for CKM and overall software quality. While 13 % disagree with the fact that the two factors in human factors are important for improvement in software quality. The results of human factors are shown in Figure 4.

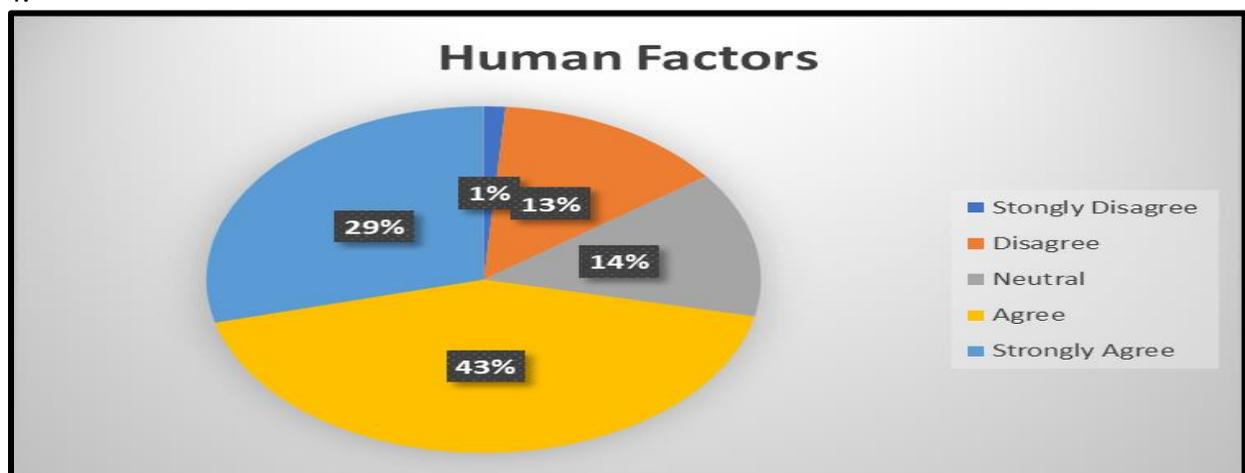


Figure 4: Figure showing the Percentage response received on the questions of Human Factors.

Technological factors group includes CRM Technology Infrastructure and Collaboration System. The response received for the two factors showed that 34 % of the survey was agreed to the stance that Technological factors contribute to Software Quality with 31% of respondents remaining Neutral and 14 % disagreeing with the fact that Technological factors contribute to software quality. The output of the technological survey section is shown below in Figure 6.

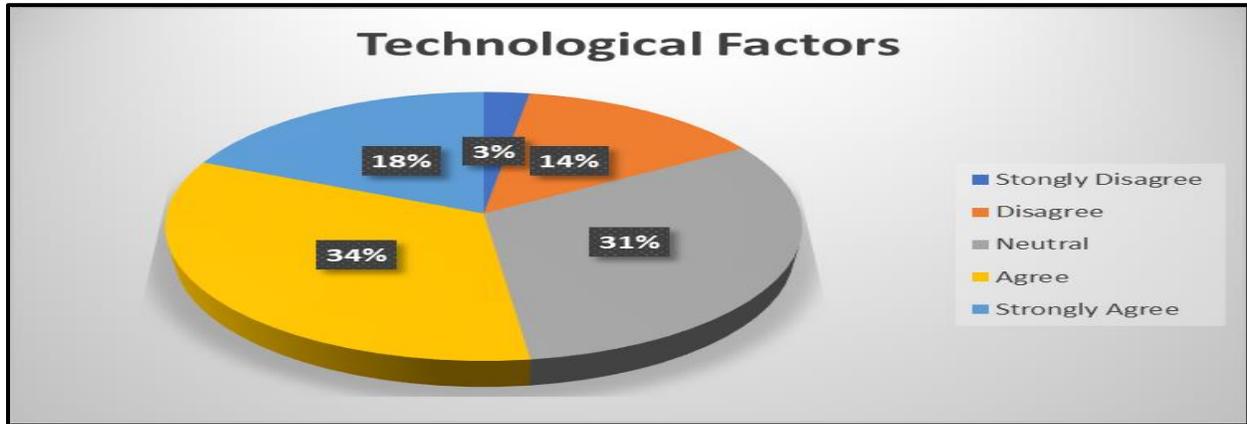


Figure 6: Figure showing the Percentage response received on the questions of Technological Factors.

The importance of CKM is a well-established fact for product quality. The survey was included with 04 questions from CKM taken from the already published studies. It was seen that 38 % of the respondents agreed to the fact that CKM is a vital part of enhancing product quality/ software. 31 % of the respondents remained neutral. The results of CKM are shown in Figure 7.

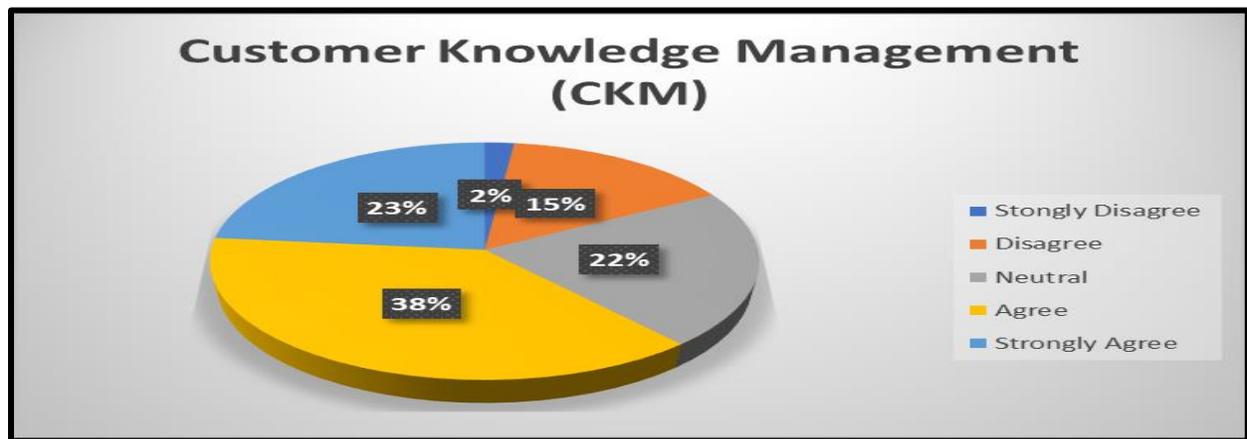


Figure 7: Figure showing the Percentage response received on the questions of CKM.

The respondents were given specific questions on the quality of the product/software. Figure 10 shows the responses received in this regard. 38 % agreed to the fact that software quality is dependent on the customer’s feedback as they are the end-users of the product and can demonstrate its reliability, strengths, and weaknesses. 19 % of the responses were received as neutral and 14 % were in disagreed/strongly disagreed with this fact.



Figure 8: Figure showing the Percentage response received on the questions of Software Quality.

Conclusion and Recommendations

CKM and Software quality interrelationship is well known and reported by many studies conducted in the past. These studies remained specific to the software development industry. Pakistan is also one of the newly emerging leaders in the software development sector of the world as of now hundreds of companies are providing quality services to the world's leading companies and organizations. As no study on CKM to date has been reported in the literature for Pakistan, an effort was done to report the relationship of CKM, and Software quality based on many hypotheses as detailed in the above chapters.

The study at the start took into consideration literature reported in well-known publishing agencies. This helps us to align the scope of the study in a manner effective and objective-oriented. The study was designed with a questionnaire-based which was taken from the literature review and each question was designed to best explain the research hypothesis. The main contributing factor of the research was defined as CKM for the quality enhancement of software. The designed questionnaire was subdivided into different sections and each section response was recorded. The designed questionnaire was circulated through emails, WhatsApp, and other social media sources to help us reach the sample size of 270 responses. The questionnaire forms were developed using online google forms which were self-gathered by the software. The data obtained from the google forms were extracted in an excel sheet which was analyzed for statistical analysis using MS-Excel, PLS, and SPSS.

The results obtained and analyzed showed significant results towards the relationship of CKM and Software Quality. The first of the contributing factor i.e. Human Factors showed that the CKM has a significant impact on the development of software. Skotis et al. (2013) in their study reported the same as our results that the relationship between Personnel skills and capability and CKM in Software Development Organizations has a significant impact to improve software quality. The second was organizational factors that include i) Customer Involvement ii) Organizational Culture, iii) Cross-Functional Cooperation, and iv) Senior Management Support Training. Lorenzo-Romero et al. (2014) in his study reported similar results that interactive data can be generated more easily when the company is practicing higher customer involvement.

The results show that technological factors contribute to software quality. Studies. Garrido-Moreno et al. (2014) suggested in their research that CRM systems are very effective in enhancing software quality through CKM. Our study is in line with the findings of Khosravi et al. (2017) where CKM has a positive relationship with the quality enhancement of software. The findings support our argument and hence can be concluded that CK is a key attribute that can help improve product quality. Skotis et al., 2013, reported that CKM and Software quality are interdependent factors and positively relate to the improvement of the quality of software. The results of human factors further confirmed that there is a significant relationship between Personnel skills and

capability and CKM in Software Development Organizations. Similar findings were reported by Stefanou et al. (2003), Vaezitehrani (2013), and Skotis et al. (2013).

The researchers studied that if the customer involvement is high, there becomes self-generating interactive data which helps to improve product quality. These results were also reported in previous studies. The fact is a widely accepted truth that top management support can help the successful implementation of CKM. Our study results are also depicted by previous studies conducted by (Attafar et al., 2013; Campbell, 2003). For the relationship between Employee Training and CKM in Software Development Organizations, our findings are different from the findings of Khosravi et al. (2017). Furthermore, Salojärvi et al. (2010) found similar results in their studies where they suggested that CRM is one of the necessary to support CKM. This hypothesis was also in line with the previously conducted studies by Mukherji (2012).

Conclusions

The conclusion of the study is elaborated under a flowchart in Figure 9.

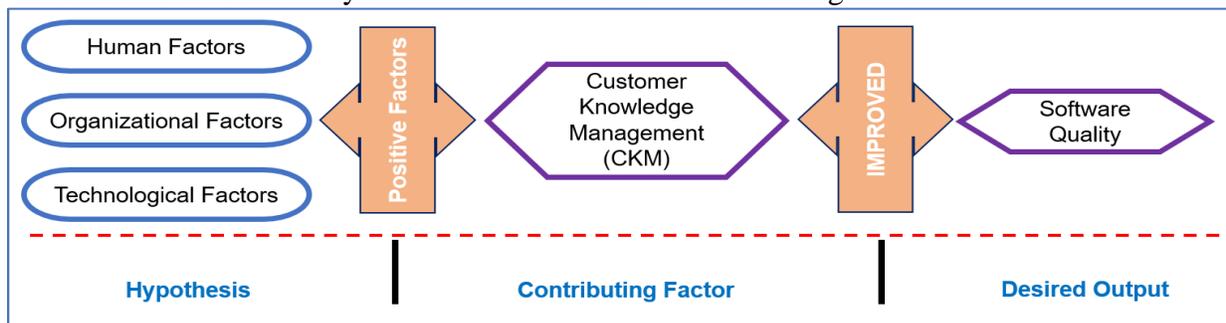


Figure 9: Conclusion of Study shown as a Flowchart.

- i. The results confirmed that 03 factors i.e., Human, technological, and organizational have an effective impact on CKM.
- ii. CKM and Software quality showed a significant relationship.
- iii. The results confirmed and supported the Generic Customer Knowledge Management framework.

Recommendations and future directions

Following are the recommendations and future directions made from the research conducted:

- i. Future studies on CKM may be conducted on a company-specific model rather than go for many. This is helpful to investigate CKM on the software quality of the company.
- ii. Customer Knowledge Management (CKM) based policies and strategies shall be proposed to help companies to reduce the risk of CKM.
- iii. The study was designed to consider the most important factors of CKM needed for enhancing software quality, while many other factors were not considered because those factors have shown non-significant effects between CKM and Software Quality. The missing/ignored factors can be reinvestigated to see the difference of effects regionally for software quality improvement by CKM.
- iv. The results of the study are generalized since the questionnaire was sent to individuals. While for a more specific approach CKM & Software quality relationships shall be checked for individual companies of any size.
- v. The study is focused on one contributing factor i.e. CKM, where different constructs were established to see the impact on software quality. Such studies can be replicated to other contributing factors in other engineering and non-engineering sectors.

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