Wiki for Global Knowledge Management in Distributed Software Development Process

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Submitted in partial fulfillment of the requirements for the degree of Master of Science in Information System to Department of School of Computer Science, Physics, and Mathematics

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## Abbreviations

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<th>Abbreviation</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>DSDP</td>
<td>Distributed Software Development Process</td>
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<tr>
<td>DSD</td>
<td>Distributed Software Development</td>
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<tr>
<td>ICT</td>
<td>Information and Communication Technology</td>
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<tr>
<td>CTO</td>
<td>Chief Technology Officer</td>
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<tr>
<td>SECI</td>
<td>Socialization Externalization Combination Internalization</td>
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<tr>
<td>HIB</td>
<td>Harbin Institute of Technology</td>
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<td>LNU</td>
<td>Linnaeus University</td>
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<tr>
<td>HTML</td>
<td>Hypertext Markup Language</td>
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<tr>
<td>URL</td>
<td>Uniform Resource Locator</td>
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<tr>
<td>CI</td>
<td>Collective Intelligence</td>
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<tr>
<td>IBM</td>
<td>Institute of Business Management</td>
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<tr>
<td>UK</td>
<td>United Kingdom</td>
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<tr>
<td>USA</td>
<td>United States of America</td>
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<tr>
<td>FAQ</td>
<td>Frequently Asked Questions</td>
</tr>
<tr>
<td>GSD</td>
<td>Global Software Development</td>
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<tr>
<td>ISOK</td>
<td>Integrated Specialized Organization Knowledge</td>
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<tr>
<td>DCOK</td>
<td>Demanded Complementary Organizational Knowledge</td>
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<tr>
<td>CMOK</td>
<td>Correlating Mutual Organizational Knowledge</td>
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<tr>
<td>SCOK</td>
<td>Sharing Contextual Organizational Knowledge</td>
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<tr>
<td>VL</td>
<td>Virtual Learning</td>
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<tr>
<td>OL</td>
<td>Organizational Learning</td>
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Abstract

Problem Area/ Purpose

The purpose of this research is to study how geographically scattered employees learn and create new knowledge with the help of wiki tool in distributed software development process. We aim to analyze how wiki supports four modes of knowledge conversion process model and how wiki helps in solving the complex problem in virtual organization learning.

Research Methodology

In this research qualitative interview study was used. We have conducted the interview with eight developers and experts in the company. Nonaka and Takeuchi (1995) knowledge conversion model was used while conducting the interview with developers. Similarly, in this research same knowledge conversion model was used for interpreting the answers that we got from the developers and experts.

Findings/Conclusion

Wiki as a knowledge management tool is possible for providing effective as well as efficient communication as per necessity of knowledge requirement in distributed software organization. The use of wiki in the organization for the virtual learning is really beneficial for knowledge creation, solving the complex problem and obtaining the useful effect on virtual team. Some drawbacks were also seen by the expert and developers in using wiki. Those drawbacks were all about genuineness, authenticity, accuracy, trustworthy and uniqueness of knowledge content.

Research Limitation & Delimitations

Due to geographically dispersed location of research sites, we faced difficulty to gather information related to company documents, reports and contextual information of organization. We will be conducting this research in the offices of Pakistan and office in USA.

Outcomes

The research that we have conducted showed that the developers in Software Company can share knowledge and also can learn through different modes of knowledge conversion model. This research also showed that developers are using the wiki tool for creating new knowledge as well as solving complex problem. This research helps in showing the benefit for other company and motivates the virtual organizations for implementing the use of wiki for different purposes.

Keywords: Virtual : Organization Learning, Virtual Team, Knowledge, Knowledge Creation, Wiki, Web 2.0, Distributed Software Development process (DSDP), Knowledge Content, Virtual Environment.
Acknowledgement

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Thanks goes to Library staffs, Department of Physics, science and Mathematics and the IT staffs in the University for Providing Support and help during the project.

Our deepest gratitude to senior and junior software developers of Folio3 Company. We would like to thank to company management and other staffs for providing us the valuable time for completing this Research. Similarly, we would like to thank Muhammad Abdullah (CTO) Chief technology officer in Folio3 company, Harun Rashid (Senior Software Architecture) as well as Intikhab Alam (Senior software developer) for providing the continuous support and help during our research work. Thanks for the Staffs of Folio3, USA office. In addition we would like to thank to our colleagues for their support and motivation.

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1. Introduction

The first chapter of our dissertation starts with overview of the topic and also contains focus on concepts such as creation of new knowledge, wiki for learning and training purpose and wiki in software industry. The first section of our report presents the problem area, purpose, research question, justification, scope and limitation of the research work.

1.1 Overview

Rapid growth and advancement of technology is making organization easier to perform different types of tasks. In the globalized organization, knowledge sharing and knowledge creation is of great importance. Knowledge sharing and creation is in higher side in distributed organization. Due to knowledge based economy it is very difficult for organization to neglect the domain knowledge that is shared, regenerated and integrated for avoiding business obsolescence as well as devolution of the process of knowledge creation (Samarah et al., 2007).

In virtual team environment, individual work across space time and perform, a collective and complex task in order to gain objectives and outcomes of organization. In distributed nature of work, specialized and contextual knowledge is not often shared and realized through face to face interaction of employee. Regarding this approach, ICT is providing different kind of option to support remote team member’s behaviors and social presence in shared context (Alavi & Tiwana, 2002).

The improvement and development of web 2.0 technology are growing faster in recent years. Use of tools like blogs, wiki, bookmark-sharing etc is seen in different institutions and organization as well. These are the part of growing trend in creating and sharing of information. The capability of conversation on those tools helped the decentralized corporation and eliminates distance that have restricted in sharing common interest (Farrell, 2006). Use of web technologies let various types of information and knowledge to be shared and gain new knowledge for organizational benefit (Leuf & Cunningham, 2001). Web technologies are part of information sharing tools which helps in today’s world for effective flow of knowledge. Sharing of knowledge with means of different tools and techniques allows user to meet in same point and share knowledge (Mader, 2007).

Wiki has been seen as major component of web 2.0, and is emergent generation of web tools and application (Adie 2006 cited in Parker & Chao, 2007). Wiki can be used as a source of information and knowledge and the tool for collaboration. Wiki allows visitors to engage in dialogue and share information among participation in different types of group projects. This further helps in construction of new knowledge (Boulos et al., 2006). The social tools like wikis, blogs allows the users to develop web content collaboratively and make open to the public (Alexander, 2006). The increment in the use of wiki depends on the community that uses for the different purpose. Wiki applications can be formed in the different social groups, private companies as well as educational institutions. Implementation of wiki can bring many advantages.
to vendors and provide quick information. Wiki can serve as the tool for the knowledge management, which helps in planning and proper documentation of the projects (Ebersbach et al., 2006).

1.2 Problem Area

Knowledge Creation in the organization is difficult without involvement of the individual (Nonaka, 1994). Currently software organizations are facing problems and challenges regarding information related to software project and sharing of knowledge. The problems regarding the transferring of tacit knowledge into explicit knowledge is also up to high. Mainly organization face problem in identifying the content, location and use of knowledge in software organization (Rus & Lindvall 2002; Rech et al., 2007).

Software developers are always demotivated to adopt software development process in a right manner just because of lack in supporting tools to create, store and search knowledge in right time (Alagarsamy et al., 2008 cited in Amescua et al., 2010). Due to globalized nature of software development, teams are located virtually in multiple places and can cause failure in sharing and maintaining contextual knowledge. Less face to face interaction among the employees, lack of social interaction in shared context, leads to misinterpretation and misunderstanding among remote team member’s behavior and attitude which brings harmful effects on team performance, team coordination and outcomes (Alavi & Tiwana, 2002). Software engineers have many qualities specially learning and acquiring a new knowledge and new skills, learning through social interaction and much emphasis is to obtain independence on dynamic learning. Companies need to focus on technological development and infrastructure for securing the software process, which helps employees in gaining new knowledge of software process, and easily exploit as well as adapt the knowledge that is gained (Biffl & Thomas, 1998 cited in Amescua et al., 2010).

Wiki helps in making best practices in software development process for the purpose of learning new skills and knowledge (Jones, 2010). Wiki is a knowledge repository tool for managing software process and supporting knowledge management activities such as creation, retrieval, storage and transfer in software development organizations (Scherp et al., 2009).

1.3 Purpose

The purpose of this research is to study how geographically scattered employees learn and create new knowledge with the help of wiki tool in distributed software development process. We also aim to analyze that how wiki supports four modes of knowledge conversion process model and how does wiki help in solving complex problem in virtual organization learning.
1.4 Research Questions

The study examines the use of wikis for learning and creating new knowledge between employees in distributed software development process. Our research is grounded on the knowledge model presented by Nonaka & Takeuchi (1995).

We aim to answer the following research question:

a. How does wiki support four mode of knowledge conversion process (SECI) in DSDP?
b. How does wiki helps in creation of new knowledge?
c. How wiki does support virtual organization learning?
d. How does wiki helps in solving the complex problem in virtual organization learning?

1.5 Justification

There is focus in software organization to manage knowledge and promote learning. Therefore ICT can be helpful to overcome the barriers of knowledge sharing and transfer of knowledge in software organizations (Bjornson et al., 2008; Feher & Gabor, 2006). Due to mediated interaction of ICTs in virtual team environment, it is facing complexity including lack of social presence in shared context, changes in organizational structure. Different kind of back end and front end existence of reasons and ignorance of social issues cause problem in knowledge sharing and creation (Baralou, n.d).

The teams are situated virtually and perform mutually dependent tasks through cross functional effort of member which is to be considered in virtual environment. Due to virtual nature of teams most of the work is done through electronic media (minimal face to face interaction) where project knowledge or outcomes are more difficult in transferring and delivering (Malhotra & Majchrzak, 2004).

However organizations find knowledge management through software package and effective knowledge management tool because it is easier to buy a software package rather than creating environment or atmosphere in which people create and share knowledge (Payne, 2008). Organization requires a tool to support different levels of learning software development processes and seek global knowledge management in organization. Thus, the tool becomes supportive for internal project and now we expect this tool helps in information sharing and creating knowledge (Prikладnicki et al, 2003 & Garcia et al, 2009). The research will explore the use of wiki as global knowledge management tool for the creation of new knowledge between developers in Distributed software development process.
1.6 Scope and Limitation

According to our case in distributed software development, single multi site organization will be investigated. In this study, External validity threat might have chances to impose during research study. Due to geographically dispersed location of research sites, it is very difficult for us to gather information related to company documents or reports and contextual information of organization. We will be conducting this research in the offices of Pakistan and office in USA.

The focus area of our study is the usage of wiki in support of new knowledge and learning purpose rather than technical implementation. The IT department will be responsible to handle this situation and all matters concerned with them regarding technical issues.

The other limitation of our study is related with timeframe since we are bounded by short period of time. We do not have resources to search the articles and journals others than LNU (Linnaeus University) domain databases. So, we are restricted to carry out research on limited resources under the authority and control access rights of university.

It is difficult for us to take direct observation since we are far from research sites. The insight views perception and behavior of developers along with other official people cannot be understood. We rely on interview to get insight views of employee’s behavior towards wiki which is one of the limitations. We will be facing problems during the collection of data from designated research sites because every organization has different norms and values which describe the nature of business, confidential policies, privacy, rules and regulations which is other limitation of study.

1.7 Responsibility of Work

We two Ashok Sharma Adhikari and Zuhair Haroon Khan Planned to do Master thesis together and started discussing the various topics. Time came to submit the proposal and we were given deadline to submit proposal. We were little bit worried in making draft of the proposal. My friend Zuhair talked to one of the Leading software company in Pakistan, which is named as Folio3. The manager coordinated with the Office in USA. It has its offices in the different cities of Pakistan and office in USA. Zuhair talked to manager of the company in Pakistan for the coordination of our thesis work. Finally, after few days we were informed that, they would help us in our research work.

We started writing the proposal. After few days of writing, we made a presentation and it was approved after making some changes. Our thesis topic is *Wiki for Global Knowledge Management in Distributed Software Development Process*. Now, time came to start the thesis.
Supervisor was assigned and we started co-ordinating with our supervisor and got involved in the research.

We started writing first chapter that includes different topics including creation of new knowledge, wiki for learning and training purpose. We both used to meet in the library and started discussing about doing thesis. We completed writing problem area, purpose, research question, justification and limitation of the research work. In the same way we started writing literature review. We used to be in the library and keep on searching literature. We discussed and finalized the topics to be used in literature review. We divided the literature topics and started writing on our own. After writing the literature, we merged and finalized the second chapter of the Literature review. In Writing, third chapter (Research Methodology), we discussed with our supervisor and finalized our research question as we made for the research. This chapter was also combinely discussed and written. In the (Empirical Findings) fourth chapter, the data were collected for this research. While Doing this chapter I (Ashok Sharma Adhikari) had to leave Sweden and go back Nepal because of some reasons. I could not give more time in this particular chapter for the collection of the data but i used to be in skype with Zuhiar Haroon Khan. Zuhair was much busy than me in this particular chapter. In the fifth chapter (Empirical findings detail and results ) Zuhair helped me in sending the data that were collected during the research. We divided the work here in this chapter and started continuing the work. I used to be online in skype from Nepal. Zuhair used to send me his work and i used to merge the document. In this way we did this chapter. In the sixth chapter (Analysis and End Discussion) we did same as the chapter five. Similarly, in seventh chapter (End results and conclusion) of our research i wrote the end results of the research and zuhair wrote conclusion of the thesis on having discussion. In this way we did this research in the Folio3 company.

1.8 Disposition

This research has been divided into seven chapters. In the first chapter, overview of the research is presented which is followed by problem area, purpose and the research question. Topic of study is justified here in this topic with necessary arguments of the study area. The first chapter ends with scope and limitation followed by Responsibility of work and disposition. Second chapter of this research includes the Literature necessary for the research work. It includes the various topics related to the previous studies. Third chapter includes the research methodology where the research method is explained in detail along. Fourth chapter of this paper includes empirical findings of the research carried out where details of the interview taken are explained. Similarly empirical findings detail and result is presented in chapter five which is followed by concise summary of interviews. Sixth chapter of this research includes analysis and discussion which includes the result findings that we got from the interviews. Seventh chapter includes the end results and conclusion of this research. This chapter also includes recommendation for the organization where we conducted this study. Finally, we try to explain the future research which can be conducted in globally distributed organization in the same chapter.
2. Literature Review

The second chapter presents the models and theories that are related to this dissertation. The chapter initially explains the literature work of research findings, later on it describes models and theories. This chapter describes the central idea of research study and will be used in another chapter for empirical finding and analysis.

2.1 Wiki

2.1.1 Web 2.0

Rapid and huge development in web technology have created interactive and user friendly platform. The presence of web 2.0 helps in different types of publication which can be changed from static view to interactive view. Web 2.0 has been an initiator for online publishing and this leads towards the communication as well as sharing of information (Toma et al., 2009). Web 2.0 is the second phase in the web’s evolution and is attracting the attention of IT professionals, business as well as web users. Web 2.0 concentrates on common type of application such as blogs, video sharing, social networking in which people will be able to contribute as much as they can consume (Anderson, 2007).

2.1.2 Social Software

Web 2.0 consists of different explanations regarding the definitions. (Klobas 2006, cited in Raffl, 2008, p.86) explain social software as ‘Software that facilitates social interaction, collaboration and information exchange, and may even foster communities based on the activities of the users’”. Konsonen & Kianto (2009) explains that social software incorporates structure of computer-mediated communities and let people collaborate and communicate through communities.

Howard Rhein-gold and his working team define social software as a “set of tools that enable group-forming networks to emerge quickly. It includes numerous media utilities and application that empower individual efforts, link individuals together into larger aggregates , interconnect groups, provides metadata about network dynamics, flows and traffic allowing social networks to form, clump, become visible and be measured track and interconnect” (Saveri et al., 2005 cited in Raffl, 2008 p.86).

Software tools can be categorized into two forms, which are traditional and social. The structure of traditional software is based in the top down hierarchy and they have slower response time. In other way, social software has bottom up hierarchy in their structure. They consist of flexible structure. In comparison to traditional software, the social software has quick response (Payne, 2008).

Traditional software has start point with the project or the organization where structure is defined before use. On the other hand, social software has start point from user and structure emerges
from the use of software. In the traditional software there is the central control mechanism and the knowledge belongs to experts and finally knowledge is shared in a formal way. Knowledge is shared in informal way in social software. Wikis, blogs are the examples of social software and tools like the Lotus notes are considered as the traditional software (Payne, 2008).

2.1.3 Definition of Wiki

The term 'WIKI' has been derived from the Hawaiian phrase, “Wiki-Wiki” which means quick. Wiki is the collaborative website where contents can be edited by visitors and allows the users of the wiki to edit collaboratively which then results the sharing of knowledge (Chao, 2007). The popular success has meant that the concept of the wiki as a collaborative tool that facilitates the different production of a group work (Ebersbach et al., 2006).

Wiki’s have been used as social software tools as they are being perceived and being connected with the users for the development of content of web collaboratively (Alexander, 2006). Application of wiki’s in organization is designed for support of functions which gives working staffs to put different types of information (O’Leary, 2008). According to (Bell, 2009) wiki are results of various types of ideas, views which are made by different people.

Wiki’s can be edited which helps in expanding the content and can be seen as the benefit from it. The knowledge collected in wiki is greater than knowledge of individual. The gathered knowledge is combination of different types of experts (Grace, 2009).

Wiki offers asynchronous contribution by a group of people including experts, peers, employees and as well as the users who are in different geographical locations. Wiki serve as the excellent means to annotate information or discuss different types of evolving issues (Murugesan, 2007). According to (Leuf & Cunningham, 2001) wiki can be used in two different modes which are document mode and thread mode. Contributors create collaborative document in document mode where the discussions are carried out by contributors performing actions of posting signed message.

2.1.4 Features of Wiki

According to (Murugesan, 2007) some of the features of wiki are as follow:

- **A wiki Markup Language:** “Wiki text” Provides a short hand way of formatting text and linking external documents and contents.
- **Simple templating:** When the page of wiki text is requested, the wiki software contains wiki markup to HTML and creates the link between pages and wraps this converted content in a template to provide a consistent look to all pages in the wiki.
- **Support for Multiuser:** Hyperlinks to the pages within wiki are created automatically thus author do not need to remember or type the URL’s to link one page to another in wiki.
- **Simple Workflow.** This is one of the important features of wiki which provides facility to write, edit and publish without editorial oversight or approval. The content in wiki is
managed through change monitoring and ability of wiki to roll back to previous version. The user access and privileges can be controlled.

- **A built in search feature.** One can search for specific information or topic within a wiki with the help of associated key words.

### 2.1.5 Wiki Functions

Wiki have much application within business and organizational environment. Wiki in organization can be used for different purposes and they are designed in their own way to support different functions allowing employees to put various information (O’Leary, 2008). Some of the functions defined by (O’Leary, 2008) are explained below.

- **Meeting Setup:** Wikis can help in mitigating the information overload. The meeting can be facilitated by gathering input in advance from attendance and making it generally available. This process helps in saving time particularly in case of multiday meetings.

- **Project Management:** The companies can use wiki for capturing different information about projects. The participants can post different types of project documents, progress report and generate information related to project in wiki.

- **Best Practice:** Wikis can be used by different employees to describe best practices.

- **Competitive intelligence:** Wikis are helpful tool for gathering competitive intelligence. It is a special function that is performed by small group within organization that works in relative secrecy. With making process open and participatory the company can get better and more timely collective intelligence can be made further available to the other people.

### 2.1.6 Aspects of Wiki

The type of wiki employed may be different from company to company however task for the use of wiki is basically same. The day to day activities which are performed through wiki falls in to following three categorize. Project Locker (2006) Whitepaper, identifies the usage of the application that falls in the given categories.

- **Project Management**
  
  Wikis may be used as central repository for the process of capturing constantly updated product features and as well as specifications. On the other hand wiki facilitates organization with central database for simple issue tracking and resolution. The literature nature of wiki allows team members in tracking development history of projects over time.
• **Collaboration**
  Wiki that are used internally allow simple text based collaboration on the internal documents which are supposed to be guidelines of company, reports and as well as the product specifications. Similarly, the external wikis are used for collaboration with customers, suppliers as well as stakeholders on key business documents and projects that are in the process.

• **Knowledge Management**
  Knowledge management allows team members to share the explicit knowledge across working unit. The wiki software for collaborative web publishing has emerged as practical and economical option for creating and as well as maintaining group documentation. Wikis are mostly valuable in distributed projects as globally dispersed team may use for purpose of tracking and publishing their work (Louridas, 2006).

### 2.2. Knowledge Management.

#### 2.2.1 Knowledge

Knowledge is term where variety of definition can be found. Knowledge has been studied since early era of Greek (Alavi & Leader, 2001). Jashapara (2004, p.16) defines knowledge as “Knowledge is actionable information that allows us to make better decision and provides an effective input to dialogue and creativity in organization”.

The definition of knowledge management could be formulated or defined with context of relations to their scenario. Nonaka (1995) introduced two definitions of knowledge which is called as tacit and explicit knowledge.

Knowledge is the personal asset of human and represents mutual expertise and different efforts of networks. It is reported that more than 99 percent of work people perform is based on knowledge (Wah, 1999b). According to (Pascarella 1997, cited in Smith, 2001, p.312) “Knowledge belongs to the family of steadily increasing corporate assets like the management system, brand identity and the corporate reputation”. Further, (Pascarella, 1997 Cited in Smith, 2001 p.312) also explains that “knowledge seems invisible but it clearly drives bottom line”.

#### 2.2.2 Tacit Knowledge

Tacit knowledge is that knowledge which is in person’s experience and thoughts. Tacit knowledge is hard to transfer among personal. Unlike explicit knowledge, it cannot be in codified form. Tacit knowledge refers to experience and all the information residing inside persons mind (Nonaka, 1995). According to (Random House Dictionary of the English Language, 1971 cited in Smith, 2001) tacit knowledge is that knowledge which is easy to understand without being openly expressed. (Polyani, 1967) explains tacit knowledge as knowing more than what we
can tell and or knowing how to perform something without thinking it. According to (Choi & Lee, 2003) tacit knowledge is the knowledge embedded in mind and author further explains that tacit knowledge is transferred in form of learning by doing or learning by watching.

2.2.3 Explicit Knowledge

Explicit knowledge is that knowledge which can be easily documented and shaped (Choi & Lee, 2003). Explicit knowledge can be created, written, transferred and can be followed in organization verbally or in different types of computer program and diagrams. Different technologies can be used for codifying explicit knowledge (Keskin, 2005; Choi & Lee, 2003). Similarly (Scarborough et al., 1999) explains explicit knowledge as the knowledge that is available in the physical form. Groupware, intranets, list servers, knowledge databases allows the sharing of the organizational knowledge.
2.2.4 Knowledge Management

Knowledge management refers to a concentrated effort by an organization for management of knowledge held within organization and outside organization. Alavi & Leidner (2001) elaborates knowledge management as the systematic process for acquiring, organizing and communicating tacit and explicit knowledge so that employees make use of it and hence becomes effective and productive. Creation of knowledge has been described in the different four modes of interaction between tacit and the explicit knowledge (Nonaka, 1994). According to (Nonaka, 1995) Concept of Knowledge management is referred to the generation, storage, transfer, transformation and protection of the organizational knowledge.

Knowledge management is a systematic and explicit process to build, renew and apply knowledge in maximizing knowledge related effectiveness and returns from its knowledge assets in the enterprises (Wiig, 1997). Knowledge management can be considered as a process which helps in increasing value of the assets (Pirro, et al., 2009).

Jaschappara (2004, p.5) explains Knowledge management as, “Knowledge management is a multidisciplinary phenomenon which could be elaborated by a number of concerned literature of the respected field of IT, social sciences, applied sciences and so on. Each dimension of knowledge management handles the key stages of knowledge discovery, knowledge generation, evaluating knowledge, sharing knowledge and leveraging knowledge within a corporate culture of organization and with the help of high up to date IT tools and models”.

2.2.5 Global Knowledge Management

Desouza & Evaristo (2003) explains that Integration and incorporation of heterogeneous knowledge of firm is located locally and globally within the boundaries of organization. Knowledge is spread on a wider context and managers utilize this one for managing, integrating and as well as for innovating and creating purpose.

2.3 Wiki for Organizational Knowledge Creation SECI Model

The knowledge creation in the organization is based upon interaction of tacit and explicit knowledge. When tacit and explicit knowledge have the interaction, there is emerge of the ‘Spiral’ and thus interaction helps in creating of new knowledge (Nonaka & Takeuchi, 1995). Knowledge is created with interaction among the different types and contents of knowledge. The social interaction between the individual helps in expansion of knowledge and the social interaction process is called knowledge conversion (Nonaka, 1994). The Knowledge conversion model is main engine for the creation of knowledge (Nonaka and Takeuchi, 1995).

2.3.1 Knowledge Conversion Modes

The assumption of the creation of knowledge is created with having the conversion between the tacit and the explicit knowledge. The four modes are categorized as, (Socialization) from tacit to
tacit knowledge, (Externalization) from tacit to explicit, (Combination) from explicit to explicit knowledge and lastly, (Internalization) from explicit to the tacit knowledge (Nonaka, 1994).

(Figure 3: Modes of the knowledge creation)  
(Adapted from: Nonaka & Takeuchi, 1995, p.62)

(a) **Socialization:** This is the mode of conversion of tacit knowledge through the interaction between individuals. The individuals can acquire tacit knowledge directly from others without language. This is also learned through observation, limitation and as well as practice. One of the main processes of acquiring tacit knowledge is through experience. Without having experience, it creates difficulty in sharing each other’s thinking process. This process by which tacit knowledge is created through shared experience and thereby creating tacit knowledge is called socialization process (Nonaka, 1994, p.19). The other way of learning among people is the process of interaction among them (Nonaka & Takeuchi, 1995).

(b) **Externalization:** This is the mode where tacit knowledge becomes explicit knowledge. Externalization is the process of articulating tacit knowledge in to explicit concepts. With the means of different types of analogies, metaphors, models and the hypothesis, tacit knowledge becomes explicit knowledge (Emig, 1983 cited in Nonaka & Takeuchi, 1995). The externalization process of knowledge creation requires knowledge in the tacit form to be transformed into comprehensible form, so that individuals will understand it.

Nonaka and Takeuchi (1995) have explained that externalization mode of knowledge conversion is seen as the concept of creation which is triggered by dialogue or collective reflection. The two methods “Deduction” and the “Induction” are used for creating those concept. The two methods help in making tacit knowledge in an understandable form for other individuals as well (Nonaka
The externalization mode of knowledge creation holds the key for creation of knowledge. This mode helps in creating explicit concepts from tacit knowledge. Various types of sequential use of metaphors, analogy and model are used for making the explicit knowledge effective as well as efficient (Nonaka & Takeuchi, 1995).

(c) **Combination**: Combination is the mode of knowledge creation which involves the use of social process for combining different bodies of explicit knowledge that is held by the individual. The individual will exchange and combine knowledge with different mechanisms like meeting and telephone conversations. Explicit knowledge can be reconfigured into new form of explicit knowledge. The process of reconfiguring includes processes like, sorting, adding, re-contextualizing etc and thus it returns as explicit knowledge. The process of creating explicit knowledge can lead to creation of new and more complex knowledge is called as “Combination” (Nonaka, 1994). In this knowledge conversion mode, explicit knowledge is gathered with the help of different sources. Later in the process, gathered knowledge is captured and integrated which further helps in spreading tacit knowledge in the organization. This knowledge is edited and makes more usable (Nonaka & Takeuchi, 1995).

(d) **Internalization**: The process of embodying explicit knowledge into tacit form of knowledge is basically called the internalization. This process is related to” Learning by doing”. Internalization is the conversion of explicit form of knowledge into the tacit form of knowledge. Identification of the relevant knowledge is necessary to the individual in the context of organizational knowledge.

The knowledge verbalized or diagrammed into different documents, manuals or different forms of oral stories helps knowledge to be tacit from explicit knowledge. Different documentation helps any of the individual to internalize the experience they have and this helps in enrich to their tacit knowledge. Additionally manual documents facilitate the transfer of explicit knowledge to the other people, which helps individual to be experience from experienced individuals (Nonaka & Takeuchi, 1995).

### 2.3.2 Wiki Support Knowledge Conversion Modes (SECI) in DSDP

**Background study:**

Xin et al (2007) conducted a qualitative interview study at IBM club of Harbin Institute of technology (HIT) in which the researcher investigated history of wiki and evaluates the impact of wiki based knowledge management. In this study the main focus of wiki was for project management, training management and routine management. After conducting interview analysis, they came to close that wiki also provide assistance in knowledge conversion process from external to internal organizational knowledge which is available on internet and assembled through member of club. Members take advantages from wiki when they search and discover similar type of knowledge. However, wikis are helpful in accumulation of specific knowledge such as training materials specially guidelines for new employees and staff for training and learning purpose of organizational knowledge. The study showed that wiki has some deficiency but still presents proper solution for complex problem. For example, most of the content in wiki is unstructured which is very difficult for transfer of knowledge across the domain. But in contrast it is very helpful for managing structured knowledge content in projects.
Wiki support SECI model in DSDP (Adapted from Nonaka and Takeuchi, 1995)

- **S → Socialization**
- **E → Externalization**
- **C → Combination**
- **I → Internalization**

(a) **Socialization mode**

**Wiki supports tacit knowledge during socialization process:**

Since invention of web tool and existence of online collaboration, there is no option and support for transferring tacit to tacit knowledge available in socialization process. Due to invention of tool and technology externalization and internalization becomes the scope of knowledge exchange in organization (Volkel & Oren, 2002).

Additional study was conducted by UK Open University regarding usage and facilitation of wiki in virtual organization learning. The study demonstrated drawbacks in wiki and results that wiki was not supportable tool for online socialization (Thomas & Minocha, 2007).

(b) **Externalization mode**

**Wiki support knowledge capturing during externalization process:**

Facilitating knowledge management has been difficult in some of the organization. Most of the tacit knowledge remains inaccessible and use of wiki can assure the different needs of knowledge management such as capturing of the knowledge (O’Leary, 2008).
O’Leary (2008, p.36) explains that wiki tool have ability to collect knowledge from distributed sources of locations and satisfy needs of knowledge management criteria.

- Capturing knowledge from those who have it
- Converting knowledge into an explicitly available format
- Connecting those who want knowledge with those who have it

Learners can capture tacit knowledge and publish their work through social media tools. Wiki as a knowledge management tool is an example to capture knowledge through collective intelligence and provide opportunity in number of ways to present collaborative knowledge capturing and have social interaction (Chatti et al., 2007). Different task can be used for converting tacit knowledge to explicit knowledge with the help different options available in wiki. It includes adding knowledge content to new pages, adding knowledge content to existing pages, writing comments in existing pages (Majchrzak, 2006 cited in Sousa et al., 2010). Wiki consists of user profile page option in which wiki users access this profile page for keeping their contacts, specialties, organizational assets and utility related to project portfolio (Munson, 2008 cited in Sousa et al., 2010).

Wiki can be used from two different angles, first producer standpoint in which expert user put their contacts, portfolio (business information), and specialty on their profile pages. Second consumer standpoint where users extract their contacts and identify experts through last page, revision history and project page content (Chau and Maurer, 2005).

**Wiki supports structured or unstructured knowledge content:**

Wiki is a widely suitable tool especially in organizational environment, which gives support to collaborative knowledge sharing and creation as well as knowledge building (souse et al., 2010 cited in harrer et al, 2008; Muller et al, 2008). In another way, wiki is a powerful tool for authoring and collaborative purpose but there are some restrictions towards less support of structured knowledge wiki content (Oren et al., 2006). Wiki allows user to interact in a collaborative and distributed way to generate and organize the group ideas, innovation and structure knowledge content. Wikis are able to support explicit unstructured and structured knowledge content in terms of text, images and hyperlinks but later on it can be difficult to reuse and arranged in an efficient manner (Solis & Ali, 2010).

According to (Schaffert et al., 2008) ordinary type wikis do not provide full text search mechanism which lead to insufficient structured knowledge retrieving in a form of data and pages. Some advance features of wikis includes different options to support structured knowledge content such as annotations and linking of web pages.
(c) **Combination mode**

**Wiki support knowledge codification during combination process:**

Wiki is a kind of tool in which all organizational members are free to provide knowledge and capability to edit existing codified knowledge that may lead towards maintenance issues and problems of repositories as well as provide option to update knowledge any time (King, 2006).

**Wiki support managing and organizing existing knowledge:**

Wiki can be helpful in combination process through main wiki group contributors. Synthesizers and adders, first group involve in adding new content and second connect closely in rearranging, managing and organizing existing knowledge for executing task. The execution of tasks include incorporate ideas that has been posted on existing pages, reorganizing set of pages and rewriting whole paragraphs and rolling it back to others (Majchrzak, 2006).

**Wiki support knowledge accuracy:**

Wikis can be easily updated by any of the persons in the organization. Different wide range of company documents, company guidelines, FAQ’s (Frequently asked question) are more easily kept with high amount of accuracy (Locker, 2006).

**Wiki for knowledge reuse:**

Wikis are the technology that supports easy creation of knowledge, web pages maintenance and flexible structuring of contents that makes wiki a popular knowledge repository tool. Thus wiki helps in keeping the shared information and different resources in the organizational unit later can be re-used (Leuf & Cunningham, 2001).

According to (Oren et al, 2006) ordinary wikis do not fully support knowledge reuse and structured search but some advance feature of wikis support well structured knowledge search as well as knowledge reuse. Some author suggested that in virtual team organization wiki may be of well supportive tool for knowledge sharing and for knowledge shaping (Wagner, 2005 cited in Yates et al., 2010).

(d) **Internalization mode**

**Wiki promotes generation of new knowledge through internalization process:**

According to (Sousa et al., 2010, p.6) “As for the competencies of a learning organization, diffusion of knowledge within the organization is most developed one, efforts must be made in order to promote generation of new knowledge through the conversion from tacit to explicit knowledge”. Wiki has widely choice to generate knowledge content for linking it to other content by using hyperlinks in which users have option to work in a collaborative fashion by using single shared digital artifact. Thus, working lead towards further development of knowledge as well as knowledge building in organization.
When knowledge is captured completely, wiki consists of option to facilitate the learners for quick information dissemination across rooms and organizational boundaries. We further require attractive search technologies that supports collective intelligence which is based on well structured sources and services .They provide assistance with valuable sources through filtering, review, recommendations, feedback, criticism and rating (Chatti et al., 2007).

Sousa et al (2010) conducted a survey study at corporate IT department where purpose of study was to identify the process of SECI model in terms of using wiki. In internalization process, individual wiki user took advantage to make use of available knowledge (externalized) for internalization purpose which leads identifying relevant subject, problems, procedures and project knowledge.

2.3.3 Knowledge Spiral

This interaction between tacit and explicit knowledge is shaped by the different modes of knowledge conversion. (Nonaka and Takeuchi 1995, p.20) explains “Organizational Knowledge creation is a continuous and the dynamic interaction between tacit and explicit knowledge”. The interactions are shaped by the shifts between different modes of knowledge conversion which knowledge spiral. Those different modes are in turn induced by several triggers (Nonaka & Takeuchi, 1995).

Socialization mode of knowledge conversion starts with building “field” of the interaction which helps facilitating the sharing of experience and other mental modes. Similarly, the other mode, Externalization is triggered with meaningful” dialogue or collective reflection”. Here in this mode, appropriate metaphors helps in articulation of tacit knowledge which is hidden and is difficult to communicate without it. The combination is triggered by use of existing knowledge from other section of the organization, which helps into a new product, service and as well as managerial system. The last mode of knowledge Spiral, Internalization is triggered by” Learning by Doing” (Nonaka & Takeuchi, 1995, p.70-71).

The contents of knowledge created by different modes of knowledge conversion are different in nature. Socialization mode yields what can sympathize knowledge, which are as shared mental modes and technical skills. Externalization Outputs the conceptual knowledge. The other mode, combination gives rise to “Systematic knowledge”. This systematic knowledge includes prototype and new component technologies. Last mode, Internalization outputs operational knowledge which includes project management, production process, new product usage and as well as different types of policy implementation. The different contents of knowledge interact with each other in the spiral of knowledge creation (Nonaka & Takeuchi, 1995, p.71). According to (Nonaka & Takeuchi,1995,p.73) Organizational knowledge creation process helps in proper context for making group activities easy and creation as well as accumulation of knowledge at individual level of the organization.
2.3.4 Distributed Software Development Process (DSDP)

Software development is a business activity in which many software engineers are involved in the process of software development. The different kinds of software making operations cause to happen design, development and deployment. However frequent change in technology makes work dynamic and new problems are arrived as new knowledge, so organization often face problems in keeping track of knowledge that belongs to and raise questions as, where did they came from, and who plays important role to manage it. Therefore software development in virtual team is different idea then in comparison to single location environment (Rus & Lindvall, 2002).

According to (Tihinen & Sirvio, 2005) global software development is a kind of software subcontracting, partnership contract-based development and global business venture that is merge into whole and exploit business goals and strategies. As a result, software development has moved into a multi-site, multi cultural and geographical distributed environment. There are number of ways to present multi-site software development. Separate teams are merged to independent companies that are located at different locations and work under the same common project with having the different responsibilities dividing among them. (Saxena & Bharadwaj, 2005 cited in Kobitzsch et al., 2001).

A period of several decades has been observed and trend has been changed towards globalization of business and is necessary to be fulfilled with high software technologies and its implementation. The recent trend is not only success to change the national market into global market, it also helps the product to design, develop, build, test, deliver and deploy to the customers in the dispersed location. Now entrepreneurs are looking for the lower cost and skilled labor through remotely located software development services and outsourcing facilities. Organizations are focused to overcome the time and distance with the help of DSD to capitalize
on global resource pools, and minimize cost structure, and achieve 24/7 development time and acceleration (Moitra & Herbsleb, 2001; Moitra & Damian, 2006).

The environment where individuals in the organization work across the space, time and beyond the organizational boundaries to perform the task in the independent way and to gain the objective in an organization is defined as the virtual environment. In distributed teams, contextual knowledge is not shared and realized through face to face interaction. Different kind of ICT tool would be effective to capture and express the team’s member’s context (Alavi & Tiwana, 2002). Creating and sharing knowledge is common activity in GSD (Global software development) domain where members commonly used knowledge management tool for solving the complex problem and learning new knowledge with the help of different functions available in the implemented tools (Saxena & Bharadwaj, 2005).

2.4 Wiki for New Knowledge Creation in DSDP

Knowledge creation is a cyclic process in which individual and group members share tacit and explicit knowledge in firm (Choi & Lee, 2002). Knowledge creation is a process that provides help in development of new knowledge with the help of interaction between tacit and explicit knowledge at different ontological level (Nonaka & Nishiguchi, 2001). Another author explains, that knowledge at one level interacts with another ontological level that leads in creation of new knowledge (Graud & Nayar, 1994 cited in Alavi & Tiwana, 2002).

Wiki is a specialized tool which supports collaborative generation of knowledge, and used for knowledge building purpose as well as co-construction of knowledge. New knowledge creation occurs when people try to internalize knowledge on the work through help of wiki. Another author pointed out that more knowledge development is possible if people acquire new knowledge during internalized process from a wiki interaction with their individual knowledge. The interaction leads towards further creation of new knowledge (Cress & Kimmerle, 2008). Wiki is a powerful tool for learning and knowledge building as well as wiki has option to generate knowledge content for linking it to other content by using hyperlinks option. It mean users have option to work in a collaborative fashion of single shared digital artifact and thus working lead towards further development of knowledge as well as accessible for innovating purpose (Sousa et al., 2010).

Wiki are widely available and valuable collaborative tool used for organization environment as knowledge creation and sharing purpose (Sousa et al., 2010). (Sousa et al, 2010) conducted a survey study in a corporate IT department where wiki was used for the knowledge creation and adoption purpose in organization. Initially wiki was used in one department for some period of time and later it was spread on different teams of department. The study showed that wiki is not capable corporate tool to support members for incorporating and creating new knowledge process into daily work task and procedures. Another study was based on Qualitative data which showed a Case study of a large corporate company in the ICT industry that used wiki for internal knowledge creation and sharing. The software development project is situated in two different global sites where wiki was proposed and implemented in socio technical point of view. The wiki is further used for innovation and creation of knowledge (Konsonen & Kianto, 2009).
2.5 Wiki for Virtual Organization Learning

2.5.1 Organization Learning

Organization learning can be defined as “the process within organization by which knowledge about action-outcome relationships and effects of environment on these relationships is developed” (Duncan & Weiss, 1979, p.84).

Organizational learning is seen as an attempt for the process of making improvements in organization. The environment for learning is provided by organization where individuals learn from the improvement of organization. There are three productive methods of learning which are, the organizational inquiry which leads in improving different performance of the task, second the inquiry leading towards the exploration and the restructuring the criteria and the values for improving organization and last the inquiry which commands the organization through capabilities for learning (Argyris & Schön, 1996). In an organizational context, Learning can be understood in different levels and perspectives. The different level includes individual learning, group or organizational learning and the perspectives consist of cognition, social and the power relationship (Aidemark, 2003).

2.5.2 Virtual Organization Learning

Different nature of people work together in the common task without time constraint, geographical location, and affiliation of organization. The main concern is to adopt a virtual approach (Au et al., 2009).

Au et al (2009) conducted a survey study and was based on virtual organization learning in open source software development. In this study organization learning and open source software development projects performance were observed and investigated that how virtual organization learning take place which could affect on developer’s performance ability and work efficiency during software development process across the boundaries.

2.5.3 Wiki and Virtual Organization Learning

The most common type of task that is found in learning environment is collaboration and cooperation. In virtual team environment wiki plays the role which it helps in collaboration (Coutinho & Bottentuit, 2007). Wiki are powerful tools for collaboration and hence gain popularity in the field of education and many sectors (Lytras, et al., 2009). Wikis are technologies that support easy creation and maintenance of web pages. The flexible structure of contents makes wiki popular knowledge repository. Thus wiki helps in keeping shared information and different resources in organizational unit which later can be re-used with the world or can be restricted to a group of community for uses (Leuf & Cunningham, 2001).

Chau and Maurer (2005) conducted an exploratory case study in Wiki-based experience repository tool at Empolis, a medium-sized software organization where wiki was used for informal knowledge sharing and organization learning purpose. The wiki was also used as
supportive tool for both codification and personalization strategies. This case study highlighted some factors that affects after the usage of wiki tool.

*By using wiki Asynchronous/synchronous collaboration and communication.*
It is explained that wiki is heavily used for asynchronously collaboration purpose rather than synchronous communication in which synchronous communication has been noticed low. It is also provided with strong evidence that wiki as a tool plays supportive role for both codification and personalization strategy for easy collaboration and communication.

*By using wiki handle Structured/ unstructured knowledge content*
The research finding clearly demonstrates that it is necessary to focus on unstructured knowledge rather than structure knowledge content. Research observation pointed out that ratio of knowledge content has greater form on unstructured way in respect to structured way. There is greater necessary to build support for unstructured knowledge content.

*By using wiki to manage self-organizing process*
Most of the time, users do not get not benefit from knowledge repository tool because observation has been noticed that these tools are not used frequently for day to day software development task activities. The content that they put in knowledge repository is obsolete and meaningless for reusing purpose.

**2.6 Wiki support complex problem in DSDP**

**2.6.1 Complex Problem Solving in Virtual Environment**

There are different concepts regarding knowledge management literatures. One of the important concepts among that is knowledge efficacy. Knowledge efficacy defines to the extent to which people believe that available knowledge helps in solving different complex problem related to their job and also improving the efficiency of the organization in which they work. This all is done to make the difference in the organization with the activities (Yu et al., 2007)

Yu et al (2007) conducted a survey study among virtual communities in open source software development area. Quantitative evidences shows that learners perform brainstorming and group operation during involvement in collaborative complex problem solving situation. Participants can learn easily from explaining their conceptual ideas and innovative thinking approach.

**2.6.2 Wiki Helps in Solving Complex Problem in Virtual Environment**

Wiki tool has ability to provide help to others in solving complex problem which is seen in virtual organization as well as supports learning organization procedures which can used for solving complex problem and task (Sousa et al., 2010; Chau and Maurer., 2005; Harrer et al, 2008; Kimmerle et al., 2011). Bruns and Humphreys (2005) conducted a survey study on a wiki based tool that was employed in teaching and academic research setting at Queensland University of technology. This research explained that wiki was helpful for student collaboration as well as co-production of text through shared online artifacts. They also investigated that wiki can be
helpful in providing facilitation in simple and complex problem solving task and operation in academic information research setting.

3. Research Methodology

The third chapter of this dissertation explains the research methodology used for conducting this research and later it explains the analysis method for empirical finding. In this chapter, we also focus on how we manage to collect data. The interview process during the research is the other focus in this chapter. Ethical issues and limitation of research is included in this chapter.

Research can be defined as "the way of thinking, examining critically the various aspects of day to day professional work, understanding and formulating guiding principles that govern a particular procedure and developing and testing new theories for the enhancement of practice” Kumar (2005, p.2). Research methodology is essential in order to conduct the research in a proper way. Research methodology is also the question regarding the research design and how the research is carried out. The following things are specified by the research methodology (Creswell, 2009).

- When and how often to collect the data.
- Constructing different measures for the collection of the data.
- Choice of strategy for contacting the subjects.
- And finally, Presentation of findings.

3.1 Types of Research

There are three types of research methods which are defined as, qualitative, quantitative and the mixed method. Qualitative research approach helps in exploring and understanding meaning of individuals and group to a social and or human problem (Creswell, 2009).

The qualitative research was used in this research study. We studied how wiki supports knowledge conversion process and creation of new knowledge in distributed software development process and similarly we also focus on study of wiki about its supports in virtual organization regarding learning process and solving complex problem.

The interaction with employees for learning and creating of knowledge helps in getting understanding in the distributed software environment. Qualitative research approach is concerned with understanding meaning which people attach the action and believe with the social world (Denzin & Lincoln, 2000).

The reason behind the choice of this approach is because; qualitative research deals with seeking the understanding of participants and has to trust the members participating in the research (Creswell, 2009). Denzin & Lincoln (2005) have stated that qualitative research approach attempts in interpreting the phenomena in terms of the meaning people bring to them, which is
one of the motivating factor for this research. Myers & Avison, (2002) have stated that qualitative research approach is designed for studying natural, social as well as cultural phenomena.

Qualitative research methodology includes various types of empirical materials. Those include materials like interview data, direct observation, archival records as well as review of documents (Yin, 2009). The data was gathered through the interviews. The interviews were conducted with the software developers in the company located in different places of Karachi, Pakistan. These interviews help the researcher to obtain and get better view between the employees using wiki.

3.2 Philosophical Worldview

Social Constructivism is seen as an approach for qualitative research. In this research social constructivism philosophical worldview has been used as it helps in understanding complex world with experiences of people who live in the environment. In other words, the social constructivism worldview helps in seeking and understanding of world in which the people live and work. The individuals develop the subjective meaning with experience which is directed towards certain things or objects. The main purpose behind the use of this philosophical world view is because the research relies as much as the views of the participants. As it is said that social constructivism worldview has been used in this research, there is interaction among the different types of employees in organization and we explore the use of wiki tool for different purpose. This worldview helps in getting the different ideas of the developers who are using the wiki tool. Creswell (2009) explained that this approach helps in development of the subjective meaning and to understand the specific context.

Similarly, in other ways, social constructivism helps in construction of meaning, the situation which is forged in discussions with other persons. Being in the social constructivism, the researcher always has focus on specific settings as well as context and its presence in this research is another motivating factor for the use of this worldview (Creswell, 2009). In the same way social constructivism helps in building their own knowledge with the different types of interaction among the people, which helps in construction of the knowledge in the social context and the various activities of the people (Kelm, 2011).

3.3 Research Strategy

We have selected interview study as the research strategy in this particular study. The research is based on interview study, as the interview is conducted with the different employees in the organization. We taking this interview as the research strategy, we focus on matters regarding area of concerned topic and subjects to explain exactly what they understand and feel how they do something. We, as a researcher first evaluate the content of subject knowledge of wiki about creation of new knowledge and evaluating that how does it provide help in learning purpose.

Conversations are an old way of obtaining systematic knowledge. In other way author argues, qualitative interviews can provide with well founded knowledge about our conversational reality and thus this research helps in knowledge producing activities. Interview research study is considered as simple and straightforward which asks someone to talk about the experience
regarding the topic and it also encourages a person to explain about the life story. Qualitative research interview are the means where knowledge is produced socially during the interaction between participants and interviewer (Steiner, 2009). From this point of view, we say that interview research strategy is suitable in our study. We conducted the interview via Skype with the employees in the organization, which we called as semi-structured interview.

3.4 Research Setting

The Folio3 Company has been selected, as research site for this research study. Folio3 is one of the reputed Software Development Company. This consists of three development offices in Karachi, Pakistan and office in USA. The office in USA specially looks for selling and marketing of the developed software’s. USA office does some development work also. We will be conducting the research in the different development offices of Pakistan and office in USA.

Folio3 handles business application in different types of domain in desktop, web based and mobile platform but our focus is on mobile application development team. The team focus on development of business application by using different types of mobile operating system. Folio3 has 180 employees over the globe and 20 to 30 employee’s work under the specific mobile development department.

The Participants were professionals from development office in Karachi and small development unit in USA office and offshore marketing department. Due to tough schedule of working hours they allowed us to conduct 8 interviews from professionals who have different roles in the organization.

<table>
<thead>
<tr>
<th>No</th>
<th>Job Designation</th>
<th>Year of Experience</th>
<th>Working Location</th>
<th>Nature of working</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CTO (Chief technology officer)</td>
<td>10-15</td>
<td>USA (client office)</td>
<td>Acquiring and adopting ICT.</td>
</tr>
<tr>
<td>2</td>
<td>Project Manager/Direct technology</td>
<td>10-12</td>
<td>Karachi</td>
<td>Project management and implementation.</td>
</tr>
<tr>
<td>3</td>
<td>Software Architect</td>
<td>7-10</td>
<td>USA, Karachi</td>
<td>Software coding standards, tools and platforms.</td>
</tr>
<tr>
<td>4</td>
<td>Database Architect/developer</td>
<td>7-10</td>
<td>Karachi</td>
<td>Database designing and implementation.</td>
</tr>
<tr>
<td>5</td>
<td>Sr. Software Engineer/developer</td>
<td>4-8</td>
<td>Karachi</td>
<td>Software development in leading position.</td>
</tr>
<tr>
<td>6</td>
<td>Software Engineer/developer</td>
<td>1-4</td>
<td>Karachi</td>
<td>Software development at junior level</td>
</tr>
<tr>
<td>7</td>
<td>Sr. QA Engineer/developer</td>
<td>4-8</td>
<td>Karachi</td>
<td>Test development lead engineer</td>
</tr>
</tbody>
</table>
| 8  | Engineer/developer               | 1-4                | Karachi            | Test development at
3.4.1 Company Description

Due to the distributed nature of organization, it is necessary for the organization to have interconnection among the employees. People in organization need to communicate for the exchange of knowledge in between the staffs. The communication process is only possible through the means of wiki, a knowledge management tool. With the use of knowledge management tool the organizational staffs are able to communicate and will be able to look up the knowledge as per the necessity. The use of wiki in the organization for the learning and knowledge creation purpose is beneficial for obtaining the goal of the organization.

In order to explain the background of the company. The organization is named as FOLIO3. The organization works in the field of software development where the requirement analysis and certain development is done in United States and the development in large scale is done in the different offices of Pakistan. The organization has the focus in developing various types of computer and mobile software’s. This organization is mainly concerned with the proper use of tacit and explicit knowledge among the employees.

Folio3 is one of the leading software development companies and has been working in the field of software development area especially in mobile application development sector since few years. This organization had used wiki in the past. Due to geographical nature of setting and technology mediated interaction among employees it, creates communication feedback gaps due to improper handling of non-verbal communication. This may lead to misinterpretation, miscommunication and raise of conflict situation between virtual teams. In virtual teams, the main concern is lack of collaborative and diversifying nature of physically located team constrains as well as development and maintenance of organizational knowledge. Virtual team members are facing different kind of problems during sharing and integration of knowledge, some of the problems mentioned by (Alavi & Tiwana, 2002) for virtual team are explained as.

- **INTEGRATE SPECIALIZED ORGANIZATIONAL KNOWLEDGE (ISOK):** Due to indirect technology mediated interaction between virtual teams, members cannot be easily incorporate their specialized knowledge and fail to provide contribution on the team task.
- **DEMANDED COMPLEMENTARY ORGANIZATIONAL KNOWLEDGE (DCOK):** Employees do not have well enough searching mechanism to acquire the knowledge at the right time for solving the collective task among the virtual team members. Employee consume time for searching needed knowledge
- **CORELATING MUTUAL ORGANIZATIONAL KNOWLEDGE (CMOK):** Due to geographical nature of team, individual members are unable to interrelate each other’s

Table 1: No of Participants involved in research study
expertise of knowledge share their understanding which results ineffective and inefficient communication between the employees.

- **SHARING CONTEXTUAL ORGANIZATIONAL KNOWLEDGE (SCOK):** Due to dispersed nature of virtual teams located in multiple places, it causes failure in sharing and keeping up contextual knowledge. The failure leads to create disturbance into remote offices and team member’s behavior and attitude in the organization. It is because contextual knowledge varies from culture and technology that is used by members on their own sites.

Another important concerning issue in Folio3 is their distributed nature of work. The communication of employee’s across the boundaries is insufficient and weak due to improper handling of IT tool. Developers face trouble to get up the knowledge in proper time and hence problem occurred in knowledge innovation and creation purpose. Employees in organization need to use available tools that help people in finding various types of knowledge as per the requirement. As soon as employees the knowledge they can use that knowledge for their desired purpose. The tool that is in use helps in sharing of the organizational knowledge. “Wiki” is the main knowledge management that helps for knowledge sharing purpose. There is big concern that same tool can be used for creating new knowledge and learning purpose in the organization.

### 3.5 Data Collection

As explained above study was conducted with the qualitative approach and was based on interview study. According to (Yin, 2009) There are several ways of data collection techniques used in the qualitative approach. Some of them include like, reviewing the documents, conducting the different type of interviews and direct observation. The overall data collection process was accomplished during July to September 2012. The data was collected through interview procedure with the system analyst and different developers in Folio3 Company.

#### 3.5.1 Primary Data

The primary data in this research study was gathered from different interviews with the developers in the software development company located in the dispersed location. The interviews helped for identification of different ideas and concepts with members who are using the wiki for creating new knowledge and how the employees use wiki for learning purpose. In total 8 interviews were conducted during this research study.

There are various ways of conducting the interviews which includes, structured, semi structured and as well as unstructured. Interview allows the researcher to get in depth understanding of the contents (Minichiello et al., 1999). Further (Yin, 2009) argues that interviews helps in obtaining the most accurate and reliable data for the research. Interviews can be conducted face to face, through email discussion, online interaction and also in the phone conversation (Creswell, 2009). In this research we used semi structured interviews for the collection of data .According to (Corbetta, 2003) semi structured interviews allows interviewer to conduct conversation as he
thinks fit to ask question. This gives right to interviewer to ask question as he found suitable and can ask for clarification if the answer is not clear. This is way to set up the conversation in researchers own style. We conducted online interview with the help of Skype software. It is faster and cheaper way for conducting the interviews as research site is far from us. The notes will be taken and the interviews will be recorded if we were given the rights to record the interview.

While conducting the interviews we followed note taking procedure as (Creswell, 2009, p.183) suggest “I will recommend the researcher to take the notes in the event that recording equipment fails”. Data was collected with the following process in this study.

![Data collection process](image)

During the data collection process, data was collected with the means of semi structured or structured interviews. The notes were taken during the process. After taking interviews, we were able to make and configure the raw data and check the validity and reliability. Finally after the data validation, analysis was performed with the help of raw data that is formulated.

### 3.5.2 Secondary Data

The secondary sources of data in our research were documents that were provided by the company officials. The documents were received in a given shape and the answers help to analyze and figure out the theme of interviews taken from developers.

### 3.6 Method of Analysis
Data analysis is an ongoing process which involves different reflection of data, asking question and use of memorandums through the study. In the qualitative study, data analysis can be conducted with collecting data and as well as making interpretations and writing the reports (Creswell, 2009). The empirical data was collected from the interviewed person in the form of notes which were organized and prepared for analysis. The collected data were studied regularly to categorize the data collected from interview in relation to our theory. Based on our theory empirical data we gathered are described and interpreted i.e. providing meaning for the experience of interviewed person in the form of text. The knowledge conversion mode of Nonaka and Takeuchi (1995) was used for the analysis of the data. Those four modes of the Nonaka and Takeuchi knowledge conversion model helps in analyzing various interaction that took place during the interview process. During analysis process, tables were created with the help of gathered information during interview. The table that we create helps in analyzing and comparing the answers that we had, during interview process. The first column of table consists of question that is to be asked and the other subsequent column consists of the answers that were given by the developers.

![Figure 7: Data collected in tabular form](image)

The coding was done for the simplification of answers. The second table that is created is same as the first one. The second tables consist of different keywords instead of transcripts as in the first table. The answers were analyzed with the help of different keywords. If the information that is of no importance is seen it is removed. The keywords in the table helps us in getting general overview of answers given and it helps in identification of the most used keywords in those
question that we asked with developers. On the basis of coding that was done in the table made and information was analyzed in accordance to the Nonaka and Takeuchi (1995) knowledge conversion model.

![Appendix 3 - Coding](image)

**Figure 8: Coding technique**

### 3.7 Validity and Reliability

Validity in the qualitative research approach means the way of getting useful and meaningful inferences from particular instruments (Creswell, 2009). Validity in research is always important in assessment for the correctness of findings of research. According to (Gibbs, 2007 cited in Creswell, 2009) qualitative validity means that the researcher can check the accuracy of the findings with employing the certain procedures and qualitative reliability indicates that the researcher’s approach is consistent across different research and different projects.

Different procedures have been explained by Creswell (2009) in order to maintain the reliability and validity of the research. Some of them validation technique include triangulation strategy, member checking strategy, and rich thick description:

- **Triangulation**: This technique involves different data sources of information with the help of examining evidences from sources to build a coherent justification for themes.
• Member checking: This validation technique defines accuracy of qualitative findings with taking final report or specific descriptions back to the participants and determine whether these participants feel those are accurate.

• Rich thick description: This description may transport readers to the settings and give the discussion of an element of shared experience. When the qualitative researcher helps by providing the detailed description of the settings and provides the perspectives about the theme. It helps the result to be more realistic and richer, and it helps to add the validity of the findings.

In this research we will be adopting the member checking strategy for the checking of validity and the reliability. After formulating the descriptions, on the basis of collected data. We will send those descriptions to the participants through email. This further helps in determining the descriptions and themes are valid and reliable. Creswell (2009) explains, if themes are established which is based on the different types of data sources, and then the process conducted will claim the validity and reliability of the study.

3.8 Ethical Consideration

Lewis, (1995) explains that ethics is the branch of philosophy which deals with analysis of decisions and other actions with respect to their appropriateness in social context. Ethical consideration is one of the important things which need to be considered in the research. The considerations are essential to ensure the privacy and safety. (Creswell, 2009, p.89) argues that “Researcher develops an informed consent form for participants to sign before they engage in a research. This form acknowledges that participant’s rights will be protected during data collection’.

We as a researcher will be informing to the research participants about the procedures carried out in a research work. The purpose of study will be made clear so that there will be no misunderstanding between researcher and participants. The understandability will be assured in the process of conducting interviews. Schedule of the interviews will be discussed and the participants will not be forced to give the specific answer, they have freedom to answer our question. The time will be asked with the participants. The participants can speak freely during the data collection time. We will ensure that the personal information of participating members will not be published without their permission.

Other important thing is about assuring that, participants can withdraw their presence in the interview at any time during the process. We will ask participants and inform participants if the interview is to be recorded. We will be asking with the participants if they provide us right to record their voices. Each and every organization has their own rules and regulation, so we will assure that organizational rules will be obeyed.
Research Questionnaire:

<table>
<thead>
<tr>
<th>Knowledge Claim</th>
<th>Reference</th>
<th>Questions to Empirical</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Wiki support knowledge conversion modes (SECI) in DSDP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socialization mode</td>
<td>Wiki for support of tacit knowledge during socialization process</td>
<td>(Volkel &amp; Oren, 2002)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Chatti et al, 2007)</td>
</tr>
<tr>
<td></td>
<td>Externalization mode</td>
<td>Wiki for Knowledge capturing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Chatti et al, 2007)</td>
</tr>
<tr>
<td></td>
<td>Wiki for structured or unstructured knowledge content</td>
<td>Oren et al (2006)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Schaffert et al, 2008)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Solis &amp; Ali, 2010)</td>
</tr>
<tr>
<td></td>
<td>Combination Mode</td>
<td>Wiki for knowledge codification.</td>
</tr>
<tr>
<td></td>
<td>Wiki for knowledge accuracy and updating</td>
<td>(Locker, 2006)</td>
</tr>
<tr>
<td></td>
<td>Wiki for managing</td>
<td>(Majchrzak, 2006)</td>
</tr>
</tbody>
</table>
| Wiki for knowledge reuse | (Wagner, 2005) | 5. How does wiki support reuse of knowledge in DSDP? If yes then how  
6. What do you think that if stored knowledge is applicable for reuse? |
|--------------------------|---------------|------------------------------------------------------------------|
| Internalization mode     | (Sousa et al., 2010) | 1. How does wiki promotes generation of new knowledge through internalization in DSDP?  
2. Is wiki helpful for searching relevant knowledge that belongs to specific person? |
| (b) Wiki for create new knowledge in DSDP | (Cress & Kimmerle, 2008).  
(Sousa et al, 2010) | 1. How do you create and apply new knowledge through wiki in DSDP?  
2. What do you think that creating new knowledge with the help of wiki is accessible or not? if accessible then how. |
| (c) Wiki for virtual organization learning | (Coutinho & Bottentuit, 2007) | 1. How does virtual organization learning take place in DSDP?  
2. Do you think that wiki can be helpful in virtual organization learning within the virtual team? If yes then how. What about your perception regarding wiki in organization learning in DSDP? |
| (d) Wiki for complex problem in virtual learning organization. | (Yu et al., 2007)  
(Sousa et al, 2010; Kimmerle et al, 2011) | 1. How do you solve the complex problem in DSDP?  
2. What about your perception regarding if wiki can be helpful in solving complex problem in DSDP? |

Table 2: Research Questionnaire
4. Empirical Findings

The fourth chapter is concerned with the findings of data which was collected during this research. We are going to present the whole description of interviews conducted with the research participants who were using wiki for support of knowledge conversion process.

4.1 Description of Case

As discussed earlier in the previous heading, most relevant part is creating awareness between employees to use wiki for the purpose of creating new knowledge and learning in the organization. Due to geographical nature of company, employees are facing problems in knowledge sharing. Due to dispersed location employees have problem in face to face communication and are motivated to use the available technology. A wiki has much functionality to support users especially when he/she creates new knowledge and expand this knowledge for training and learning purpose. We decided to focus on intermediate knowledge accessible process through ICT in terms of availability in explicit form.

4.2 Structure of Interview Questions

We have conducted the qualitative interviews with participants who are involved in using the wiki throughout different activities in distributed software development process. Our interview questions were based on literature reviews that shows how developer creates new knowledge with the help of wiki and then evaluates how wiki could support knowledge conversion modes. The interviews were conducted with eight developers who are familiar in use of wiki for development purpose. Our interview questions were extracted from literature review and were asked during the data collection process.

4.2.1 Wiki Support Knowledge Conversion Mode (SECI) in DSDP

In this section, we asked total 17 questions with developers about how developers get support in knowledge conversion mode with the help of wiki tool in dispersed location. Similarly we aim to know how wiki tool can be helpful in knowledge distributing, capturing, codification and reuse purpose during knowledge conversion modes.

Socialization:

In this mode of socialization, we asked total of two questions with developers. First we asked to find, how developers share the organizational tacit knowledge that is resided in their mind and finally as the other question we asked if they share organizational tacit knowledge then how wiki tool become effective in support of organizational tacit knowledge during socialization process.

Wiki for support of tacit knowledge during socialization process

The first question we asked with the software developers was how the employees will share the organizational knowledge that is on their mind. The answers that most of the developers express and agreed that, they shared the organizational knowledge within or outside organization boundary during software development practice. Some developers have perception about the
internet portals and think that wiki is the best option to share the organizational knowledge between boundaries. Some of the developers finished the answers by thoughts as they share the organization knowledge through discussion in the training session and some agreed to share organizational knowledge over email and few of them indicated that they share knowledge with the help of wiki tool. View by the senior software engineer in folio3 office in Karachi is expressed as.

“…. We (as developer) often made a page with the information we want to [share] with the help of wiki and share the created links with concerned fellows. Later fellows comment and give their feedback for more accurate and detail knowledge”.

(Sr. Software Engineer, Folio3 Karachi office)

The second question we asked with developers was related to effectiveness of wiki tool during sharing of organizational tacit knowledge in socialization mode. Few of the developers commented positively that wiki is really helpful to support organizational tacit knowledge during the process of socialization. Most of the developers have perception that wiki does not support the socialization process for sharing tacit knowledge explain as wiki has no option available in wiki to share tacit knowledge easily to other employee in the organization.

Some developers answered as, we can share tacit knowledge through making knowledge maps that is available and accessible in form of booklets, brochures and directories. A view of software architecture in folio3 office is as,

” We as a Expert users (developer) make a knowledge folders for concerned users who need knowledge that is relevant to our projects, later on it is utilized and identified (demanded knowledge) through our specialized knowledge folders and maps”.

(Software Architecture, Folio3 Karachi & USA office)

Some developer agreed that they have to share their experiences, ideas and thoughts with the help of audio, videos, and text and pictures options available in wiki. In this way other employees can gain skills and knowledge through these shared entities. A view is expressed by an engineer as.

” We as developer often share our experiences through available options of wiki including videos, audio, text and pictures. Afterwards other users used our shared experiences for learning”.

(Sr. Software Engineer/developer, Folio3 Karachi office)

Some developer thought that they share the tacit knowledge of project through designated public platform or internal/web portals which is makes it easily in wiki tool. Database architecture in Karachi office expresses as

” Wiki has options available to connect knowledge through topics and tags, later on concerned fellows search the relevant project knowledge that will be useful for project enhancement and development”.

(Database Architecture, Folio3 Karachi office)
Externalization:

In externalization mode, we asked several questions from developers about how they converted tacit knowledge into explicit form. Later on, we focus on how wiki could provide help regarding this matter.

Wiki for knowledge capturing during externalization process

In this category, we asked three questions with developers about how they capture the knowledge which is specific and is used for organizational purpose in mobile software development process activities across the dispersed location. We ask with developers that how do developers capture the organizational knowledge during externalization process. Similarly we asked developer that does wiki be effective in capturing knowledge during global process work and further we asked, if structured or unstructured knowledge content was supported by the help of wiki.

First question we asked with developers that, how developers captured the organizational knowledge during externalization process. Developers had different point of views on the knowledge capturing process. Some argued that knowledge capturing is only possible through manual process, some commented positively through social interaction and some showed inspiration that knowledge capturing is not possible without collaborative act of work and involvement of collective intelligence. Some have perception that social media tool is helpful in knowledge capturing.

Talking about next question, we asked developers, about the effectiveness of wiki tool. And we asked, if wiki plays effective role in capturing knowledge during development process. They stated by answering that wiki tool was really helpful specially capturing the knowledge during development process. Some developers explained that all our training exercises will be loaded up in the wiki so it really helps us to consolidate all the information. Few developers agreed that wiki could not be helpful in capturing knowledge easily in the development process further they added it depends on manual process that takes lot of time to capture the knowledge.

Other developers told us that wiki was very effective on knowledge capturing through adding new pages during software development activities were carried out at work process. One of the software developers expressed us as.

“…..Truly this is an [effective way]. If we need to have feedback on some topics or any other news for the work. Simple adding new pages with options to write provide fastest way to have concerns and feedback with many employees. We can further utilize that information for making decisions and other use”.

(Software Architecture, Folio3 USA office)

Some expert commented that knowledge capturing is possible through uploading training exercise through the help of wiki.
“... All our training exercises are loaded up in the wiki so it really helps us consolidate all the information”.

(Database Architecture, Folio3 Karachi office)

Wiki for structured or unstructured knowledge content

Last question we asked if wiki was supportable for structured or unstructured knowledge content during the time of knowledge capturing. Most of developers gave arguments on their behalf of experiences. Some developer commented that wiki supports structured knowledge content when people create new pages to organize the knowledge, index, links, and bookmarks. A view by software engineer is as

“People create new pages and move data around so it’s always structured correctly”.

(Sr. Software Engineer, Folio3, Karachi office)

Some developer argued that wiki supports structured knowledge content through performing three different roles of knowledge sharing.

1. Knowledge Producer: the original creator of knowledge
2. Knowledge intermediary: The one, who packages and prepares the knowledge so that it can be stored, retrieved and shared. This may involve much number of functions such as indexing, categorizing, standardizing, publishing and mapping etc.
3. Knowledge consumer: The person who is the recipient and user of knowledge.

(CTO, Folio3, USA office)

Some developer pointed out that wiki supports structure knowledge content on the behalf of people who could submit a lot of knowledge and moderator(s) set them properly.

“... People can submit a lot of knowledge and moderators set them properly”.

(Project Manager, Folio3, Karachi office)

Most of developer agreed that wiki could be supportable for unstructured knowledge content. One of the software engineer in folio3 explained view as,

“.... We may upload /store knowledge on choice of organization either structured or not”.

(Software Engineer, Folio3 Karachi office)

Developers agreed that we manage unstructured knowledge content by the wiki; further developer explained that they create a page where they could put down everything that is in their mind. Later on they could be able to extract whatever is important and put it in a single correct place. View by software architecture in Karachi office is as ,

“You can have a page where you can put down everything you have in mind. Later on you can Extract whatever is important and put it in a single correct place”.

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Most of developer disagreed that wiki supports unstructured knowledge content and there is no support available in wiki tool for unstructured content knowledge.

“Well I do not think so, I might not aware of if any”

**Combination:**
In combination, we asked six questions and try to understand that how developers transform explicit knowledge into a more complex forms with the help of wiki. During transformation of organizational knowledge we try to know how wiki would be helpful in codifying, managing, organizing and reusing knowledge during the process.

**Wiki for knowledge codification**
In this category, we asked one questions with developers and received answers in a different form. The first question was targeting different problems that developer often faced while codifying the knowledge.

In the first question, Most of the developers commented positively and few of them gave negative comments about codifying knowledge with the help of wiki. Mostly developers provide with good comments about wiki and explain that wiki consist of many tags, keywords, phrases which can be used in different studies. Wiki helps directly in searching of those terms that takes less time and effort to find the most relevant information. Wiki do have ability to categorize the knowledge separately on various domains. We directly expressed the comments as senior expert delivered us.

“….Wiki is one of the best tools that allow us to share information among team members. It comes up with the right set of tools that allow you too easily [codify the knowledge] ”.

(CTO, Folio3 USA office)

“The problem is that people keep on adding information to the wiki. You have to rely on the correct keywords to find out the right content. Coding does not really help here.”

(Project manager, Folio3 Karachi office)

“Well the problems occur when the terminologies refer to two or more areas of study. Wiki often provide the one end. Dividing information as per terms will definitely help the researchers in better way”

(Sr. Software Engineer, Folio3 Karachi office)
Wiki for knowledge accuracy and updating

In this category, we asked two questions with developers regarding how wiki would be helpful in securing knowledge accuracy and support knowledge making up to date in distributed environment.

Our first question was about making the accuracy of knowledge and making it up to date. We asked them how wiki supported for keeping organizational knowledge up to date and accurate. If yes then how? We received both answers in positive and negative way. The developers who answered negatively and provide explanation that knowledge accuracy totally depends on the shoulder of administrator or owner who are responsible for creating the content accurately.

“...I don’t think there is such support in wiki tool about accuracy, so it can be implemented or it is up to the owners who are responsible to the content”.  

(CTO, Folio3 USA office)

The rest of the answers were positive about discussion on accuracy of organizational knowledge. The expert told on behalf of their experienced that wiki has ability to identify the accuracy of knowledge content (organizational knowledge that has been developed during development process) and reducing the confusion about information that is available in wiki. Software developers always rely on knowledge content that is provided by the organization.

“...... Since wiki is a central location which always has updated information, it helps us reducing confusion about information and knowledge”.  

(Project manager, Folio3 Karachi office)

Another expert views about accuracy of organizational knowledge through knowledge content which was supported by wiki is.

“.....Wiki investigation of content helps the [accuracy of knowledge]”.  

(Software Architecture, Folio3 Karachi office)

Most of the developers agreed that wiki supports for keeping organizational knowledge up-to-date. Most of them answered that wiki have options and features available that allows knowledge to update in central location with making new knowledge or making change.

“..... Since everything is at a central place, the data has to be [updated]. If it is not, other people take responsibility and update it”.  

(Sr. Software Engineer, Folio3 Karachi office)

“..wiki tools such as Wikipedia are very [updated and accurate]. They have volunteers who keep the knowledge up-to-date or any user can go in and update the wiki. As soon as there is an
update, a volunteer would verify the change till then that updated piece would be highlighted as red”.  

(Software Engineer, Folio3 Karachi office)

Little developers did not agree that wiki could be helpful in supporting and keeping knowledge up to date. They argued that updating knowledge depends in the effort of administrator or owners who are responsible in update the content.

“...I don’t think there is such support in wiki tool about to [updating], so it can be implemented or it is up to the administrator who is responsible to the content”.  

(Sr. QA Engineer, Folio3 Karachi office)

We received ordinary answer from a developer about the perception of knowledge updating with the help of wiki. He answered as,

“... Wiki allows users from the world to share their [updates/stats] the topic”.  

(QA Engineer, Folio3 Karachi office)

The second question has relation with previous one; if wiki was helpful in making accuracy of organizational knowledge, why it is necessary to consider for knowledge accuracy. Every developer had different point of views about knowledge accuracy. Some developer told us that wiki was very helpful as users have ability to revert the older version of knowledge easily.

“.....Its central base people can edit it. Developer can revert back easily to an older version”.

(Software Architecture, Folio3 Karachi office)

Most of developer agreed that knowledge accuracy is not dependent to wiki feature; knowledge accuracy only depends on volunteer’s users, people who run the wiki.

“..... It is not the wiki features and options; it is the user’s volunteers, people running the wiki that [makes it accurate]”.  

(Sr. Software Engineer, Folio3 Karachi office)

Another developer answered with different opinion about knowledge accuracy through wiki tool.

“... If knowledge is not [accurate], users will not visit wiki, I think that sharing of data is the main reason behind its popularity”.  

(Software Engineer, Folio3 Karachi office)
Wiki for managing and organizing knowledge

In this category, we asked developers if wiki could be helpful for managing and organizing knowledge in efficient manner during distributed software development process. A couple of developers pointed out that wiki had ability to organize knowledge in well structured form through the help of different wiki pages, index pages and searching content. Developers demonstrated in the following way.

“…… We put the information and organize by creating different pages, and index pages which is done and created for easy navigation. Wiki also support the searching of content “.

(Sr. Software Engineer, Folio3, Karachi office)

Other developers pointed that wiki was not fully able to organize knowledge on the right time at the right place as well as not in well structured form. Some developers stated that we could organize or arrange knowledge through wiki documents with options available in the wiki tool. They gave us positive answers though, wiki was great for developers especially in software development environment where knowledge every time rotates and new knowledge comes and turn towards complex due the changing of demand. In that stage, developers need tool to support the work in well supported manner.

“….. We as a developer collect the knowledge from the wiki and [arrange them] by using wiki docs”.

(Software Engineer, Folio3 Karachi office)

Other developers told that we organize knowledge through different wiki pages that is concerned to all organization areas.

“…. We have different wiki pages for all organization areas, meanwhile we able to [organize it] in a proper way”.

(Project Manager, Folio3 Karachi office)

Most developers told us that they use wiki to discuss knowledge through organizational knowledge bases which is available in wiki. The most attracting thing they told us in wiki use is that it helped company knowledge bases which made them easier to play with knowledge. The company employees are able to utilize knowledge from the knowledge bases in an efficient manner.

“…. Using wiki we share our knowledge in knowledge bases and hence other people can [utilize it] ”.

(Database Architect, Folio3, Karachi office)
In later phase, most of the developers answered that they used knowledge which was given as comments on shared work activities. Further the people discuss knowledge with the help of comments received and mentioned in shared activities of software development process.

“…. Mostly through comments given by people in wiki tool and we discuss them about”.

(Software Architecture, Folio3, Karachi office)

Finally expert expressed their comments about organizing knowledge. Different answers were received on both positive and negative way. The developer who answered negatively told us that wiki may provide assistance regarding managing and organizing knowledge but not in efficient manner as well as not in effective way.

“..It takes time to organize and manage knowledge that is available in the tool”.

(QA Engineer, Folio3 Karachi office)

Most of developers answered positively and told us that wiki helps in efficient management and helps in organizing knowledge that is available inside the tool. The answer explained was

“... yes it can, however there has been a lot of information in the wiki to make it successful”.

(Sr. QA Engineer, Folio3 Karachi office)

Developers expressed their views on different way, such as developers manage knowledge by making different pages and tags. Few developers agreed on statement and told us we setup a wiki on different areas of organization such as human resource, Admin operations and others for technical areas of knowledge where. Wiki helps in managing all organizational knowledge. A senior expert told us regarding managing knowledge with the help of wiki as.

“……We could manage different topics/ subjects/ departmental stuff in separate folders, wiki provides with editing of shortcuts on main page (dashboard), adding favorites links in menus, recently added material links and recently surfed links by users etc”.

(CTO, Folio3 USA office)

Wiki for reuse of knowledge

In this category, we asked two questions with developers asking how developers utilize existing organization knowledge for reuse purpose sin distributed software development process with the help of wiki tool.

We asked first question with developers on their perception regarding wiki about reuse of knowledge. We got positive answers from developers that wiki was very helpful especially in the process of reusing knowledge in distributed software development process. Most of developers answered positively that wiki saves a lot of time as developer have to spend a lot of time in the development process.

“… sometimes the information gets old. When the information is still valid, it helps in saving a lot of time from [reuse] “. 
Developers explained that wiki could be helpful in reusing of knowledge in work through intelligence search. They further added that Wiki is helpful in finding right content at right time, through search functionality and options. Project manager stated that.

“…you can search the right content and then we use it to solve your problems”.

(Project Manager, Folio3 Karachi office)

Another developer stated that:

“…. Intelligent search system should be integrated to get [reusability of knowledge] to work”

(Sr. Software Engineer, Folio3 Karachi office)

Some developers agree that with adding and updating information it is possible for reuse of knowledge.

“... Wiki allow the users to add and update information to the topic. In this way knowledge can be reused”.

(Database Architect/developer, Folio3 Karachi office)

Some developer commented that knowledge reuse is possible with the help of wiki through existing knowledge bases that is integrated in wiki tool. Developers have option to utilize the existing knowledge base for reuse of knowledge purpose into software development activities; further more reused knowledge could be helpful in building a new product.

“... Knowledge driven from existing knowledge base”.

(Software Architect, Folio3 Karachi office)

Some argued that knowledge reprocessing and recycling was only possible through knowledge content which was genuine, trustable, and unique due to centralized and localized nature of content which gets support with wiki on the basis of functionality and features.

“... I think wiki content is trust worthy if data is unique and knowledgeable, so knowledge [recycling] helps in further utilization of knowledge for specific purpose in software development activities”.

(Sr. Software Engineer, Folio3 Karachi office)

The second and last question we asked with developer is that, if stored knowledge is applicable for the reuse again through wiki. All developers agreed on statement that wiki helped to stored knowledge and recycle again with the given functionality and features of wiki tool.
“Yes it is, most of the time the basic reason of setting up the wiki is sharing and what I’m thinking is sharing of knowledge proceeds to reusing. Since wiki share its knowledge, it can be [reuse]”.

(Software Engineer, Folio3 Karachi office)

Some commented their sentiments on stored knowledge that is possible to reuse again through wiki.

“.Of course once stored knowledge can be accessed again and again”.

(QA Engineer, Folio3 Karachi office)

Another developer pointed that knowledge without reuse was useless in software development process activities because developers always rely on existing knowledge, and reuse is in existing knowledge for further enhancement and conclusion.

“Knowledge without reuse is useless, we may update the existing knowledge, and may get new conclusions from existing knowledge etc”.

(Database Architect, Folio3 Karachi office)

**Internalization**

Internalization is a kind of process which helps in incarnating explicit knowledge into tacit knowledge. Explicit knowledge is scattered into individual’s group and organizational level. Learners have opportunity to learn new kind of organizational knowledge and use this knowledge for further innovation in organization

**Wiki promotes generation of new knowledge through internalization in DSDP**

In this category of section, we asked one question from developer about promotion of wiki and generation of new knowledge through internalization process. Most of developer commented that wiki allows user to make knowledge content easily of their business knowledge. One of the employees in folio3, Karachi office expressed as

“We can develop our own mixed, edited and synthesize project specific knowledge content within a shared digital artifact with the help of wiki”.

(CTO, Folio3 Karachi office)

Some developer commented that specific project knowledge content was helpful in promotion and generation of new knowledge with the use of hyperlinks, images and text. They explained that they can connect knowledge content to other knowledge content with the help of hyperlinks, images and text then generation of new knowledge is possible in a collaborative way of fashion. Few developer commented that wiki make accessible for distributed environment where developers distinguished to each other in a geographical form and perform knowledge sharing
and creating activities through creation of specific knowledge section. One of the architect explained as,

“In wiki, we create specific knowledge section or stub related to our business project knowledge, later on other members who are located in different region can be able to add their content as freely”.

(Software Architect, Folio3 USA & Karachi office)

Little developer agreed in one level that, wiki knowledge content was helpful for generation and promotion of new knowledge in restricted manner. They point out that there is no guarantee on wiki about accuracy, truthfulness and professionalism. They explained on their views

“By using wiki it is not guaranteed that we create knowledge content and is applicable for other member to utilize it on efficient and effective manner as well as integrate for knowledge generation purpose.”

(Software Engineer, Folio3 Karachi office)

Second question that we asked with developers was about searching relevant knowledge to specific person with taking the help from wiki. Different developer’s explained their views on their own ways. Some expressed their views in terms of adding information to the wiki. It was explained that they had to relay on the correct keywords to find out right content in right time. It was very hard to identify right tags and keywords, and they thought finding relevant knowledge is supportable and helpful through wiki tool. Some developers argued that there is lot of improvement and management required in wiki, it provides only basic level of formatting which is very far away from what Microsoft Word provides in terms of formatting the text. Few told us that they face problem when terminologies are referred in two or more areas of concerned study. It was added that wiki only provides one area of study, so dividing information as per the terms would be helpful in searching in a better way. Finally another argument was noticed and mentioned as following.

Knowledge codification problem occurred due to the precise wordings in which you would like to describe the subject matter (organizational knowledge that represent with specific keywords); words that target users from various different knowledge background that represents to summarize the knowledge, presenting the knowledge, establishing / verifying the authenticity of the knowledge and measuring the implications / effectiveness of knowledge”.

(Project Manager, Folio3, Karachi office)

4.2.2 Wiki for New Knowledge in DSDP

In this category section, we asked two question with developers, which is related with gaining and creating new knowledge with the help of wiki tool for learning and training purpose. We also try to understand that either new knowledge they gain during software development process is accessible or not with the help of wiki.
The first question we asked with developers was concerned about creation and applying new knowledge with the help of wiki in distributed software development process. The developers answered on different formats, some agreed that wiki could be helpful and some argued that wiki could was not supportable for gaining new knowledge. Developer who did not agreed on wiki’s support for creation and applying is as.

“... I don’t prefer wiki for new knowledge rather I use multiple resources”.  

(CTO, Folio3 USA office)

A developer who commented positively explained view as

“... People who solve a problem keep it on the wiki and it helping gaining new knowledge. Similarly training information about new technology can help us as well.”  

(Project Manager, Folio3 Karachi office)

Some developer added that wiki could be helpful in creating knowledge if information is organized properly. A view by software architecture in Karachi office is written as:

“...Through email updates, only useful information is organized properly”.

(Software Architecture, Folio3 Karachi office)

And another one expressed in the other way:

“Wiki can be quite helpful in organizing knowledge and it helps in access to the information in very easy way”.

(Database Architect/developer, Folio3 Karachi office)

One of the developer indicated us that, wiki could be helpful for creating new knowledge if developer committed to read and agree to communicate each other, what other developer have given explanation on specific purpose and cannot rely on bookish information that was stored in the tool.

“... You can read what other people say and it’s not only bookish information”.

(Sr. Software Engineer, Folio3 Karachi office)

In the first question, second part was concerned about applying new knowledge how they apply new knowledge with the help of wiki. Most of developers have their own views regarding the apply of new knowledge with the help of wiki. Some gave direction that if they talk about tool options and features then they could say that tool has flexibility to implement new knowledge without any further delay. A comment by software developer in folio3 Karachi office is as

“... If it is about learning a new tool or technology, the tool and techniques are provided in the wiki post”.

(Software Engineer, Folio3, Karachi office)
A QA engineer explained, about applying new knowledge with the help of content available in wiki.

“...it is not wiki that helps but the content in the wiki is helpful”.

(Sr. QA Engineer, Folio3, Karachi office)

Some developers debated that they do not have experience in applying new knowledge with the help of wiki but have categorization of knowledge content on the basis of subjects. It would be possible to help out implementing a new knowledge with the help of wiki tool. Every subject represents the specific knowledge of specific purpose and new developer get easily access to new knowledge because of its open nature of content and knowledge defined under the subject heading which was easily searchable and approachable.

“... Although, I haven’t done it yet, but I would suggest categorizing stuff that is based on subjects”.

(QA Engineer, Folio3, Karachi office)

Second question we asked with developers is, if the creation of new knowledge wiki was accessible with the help of wiki, then how is it. Most of developers explained and argued that it was accessible within the organization over the internet and intranet.

“.... It can be accessible within the organization over the internet, intranet and shared places

(CTO, Folio3 Karachi office)

Another developer pointed out that creating new knowledge could be accessible if information is arranged properly according to the references within proper places.

“..... It is accessible if you keep proper references in the proper places”.

(Project Manager/direct technology, Folio3 Karachi office)

One of the developer explained that it was accessible under connected group of people but not made publicly available and accessible.

“... It is easily accessible within a connected group of audience, but not made public”.

(Sr. Software Engineer, Folio3 Karachi office)

4.2.3 Wiki for Virtual Organization Learning

In this part of section, we asked 2 questions with developers regarding, how learning took place in virtual organization and second was about how wiki could be helpful in learning process in the virtual team.

We received different types of answers from developers. Many developers agreed on the statement that learning took place in organization through presentation, sharing of knowledge
through emails, through internal wiki, conducting seminars, training sessions, personnel training syllabus.

“... Learning take place in virtual organization through presentation, training session, conducting seminars, sharing knowledge through emails, letting personnel’s learn a given syllabus and implementing an internal portal/wiki and also take place when people get on new targets and research about them”.

(CTO Chief Technology Officer, Folio3 USA & Karachi office)

One of the senior expert explained that learning took places in organization through a process. First it should:

- Identify the problems which need to be resolved.
- Share the problem and getting ideas.
- Pick few related and accurate ideas.
- Call a meeting with concerned personals.
- Assign few people to address the issue and prepare solution for problems.
- Adopt the best solution presented.
- Make it official and document the solution properly.
- Store the document in the repository for others to follow and bench marking.

Some expert argued that organization has good option in learning with the help of senior peoples who provide assistance through their experienced.

“... We have a senior people who mentor juniors”.

(Project Manager / Direct technology, Folio3 Karachi office)

Second question, we asked with developers was concerned about how wiki could be helpful in learning process that held in virtual organization. All of the developers agreed that wiki was helpful in learning process because all knowledge was saved in the wiki by effort of senior employees who know precious knowledge of organization. With this effort, junior employees have option to take help from their senior employees. Developer stated that:

“... Wiki can be used so people can learn themselves. All the information can be consolidated on the wiki and juniors can take help from the senior staffs. If they run into any issues, they can get in touch with seniors”.

(Software Architecture, Folio3, Karachi office)

Another developer stated that wiki provides help in learning in a sense that, uploaded document helps juniors in taking training and get help through relevant document.

“... Yes, we may upload relevant knowledge and document through wiki”.

(Sr. Software Engineer, Folio3 Karachi office)
The developer also suggested that wiki could be helpful in learning if people are in touch and keep up to date with their findings and research.

“Yes, wiki can be help in learning if people can keep it updated with their findings and research”.  
(Software Engineer, Folio3 Karachi office)

Some expert suggested that wiki was also helpful in learning process as
- Identifying problems
- Getting ideas and solutions
- Sharing best ideas presented
- Getting feedback on the solution suggested

(CTO, Folio3 USA office)

Most of developers agree that wiki was providing help in learning. Millions of stuff was available in just one click of search and find most appropriate links appeared within a time.

“...There is now million of stuff on wiki, just search for any think, you would find the Wikipedia links on top 3 results out of millions results, that is definitely helpful”.  
(Database Architect, Folio3 Karachi office)

Some developer didn’t agree on wikis help in learning process because it takes time and explained that it was not appropriate tool specially for learning purpose in organization. They also pointed out that learning process was very slow.

“...it is going to be a slow process. Wiki will serve as another resource for research. It may help in understanding but it’s not a replacement for person to person learning.”

(QA Engineer, Folio3 Karachi office)

Another senior expert indicated that wiki was slightly helpful in learning process but it took made easier thing quicker.

“...It cannot completely take over the regular learning process but it can certainly help in making things quick”.  
(Sr. QA Engineer, Folio3 Karachi office)

4.2.4 Wiki for Complex Problem in Virtual Learning Organization

In this part of section, we asked two questions with developers concerned with solving complex problem in virtual learning organization and attention towards wiki that could provide help for solving complex problem during DSDP.

Our two question were directed towards developers and asked them, how do they solve complex problem in virtual learning organization. Many developers commented with different arguments about solving complex problem in distributed learning organization. Most of developers agreed
that when they face complex problem in organization which occurred incidentally. They perform some actions against problem.

- They call all the concerned persons and arranged meetings.
- They clearly present the agenda.
- They took different ideas and counter them with cross arguments.
- They took minutes of meeting.
- They further decide a solution and present them in front of all concerned persons.
- They finalize the process and assign different roles as per the qualification and expertise to counter the problem.

(Software Architecture, Folio3 USA office)

Some developer pointed out that they solve complex problem through research analysis and reading knowledge of people they gained through experiences, imitation, participation and observation.

“.. By having research on the topic and reading about similar problems which people have around the globe”.

(Database Architect, Folio3, Karachi office)

Some developer stated that they normally discuss complex problem with team taking help from wiki because wiki helps in solving the complex problem.

“.. We sit together and have brainstorming sessions about it. The most promising solutions are then worked upon by the team.”

(Project Manager/ Direct technology, Folio3 Karachi office)

“We normally discuss complex problems with the team, then store and implement on wiki.

(Sr. Software Engineer, Folio3 Karachi office)

Some software development expert suggested that they solve complex problem through maintaining word documents and share this document to other members with the help of Dropbox facility and finally discuss complex problems with person individually and also from conference call and then implement it for achieving goals.

“...The problem & then solution is speech out on word document and shared through Dropbox, discussed in person/conference call and then implemented.”

(CTO chief technology officer, Folio3 USA office)

In the second question we asked developers about the usefulness of wiki. The question was expressed as, was wiki helpful in solving complex problem in learning organization. If yes then how. We received both answers positively and negatively but most of developers agreed that wiki supports solving complex problem in learning organization. Some developer commented that wiki was not supportable and one of the developers explained
“.... Wiki do not have enough support to derive complex solution, but we can store relevant solutions as soon as we drive them once.”

(Sr. Software Engineer, Folio3 Karachi office)

Another developer told us.

“...Wiki can be helpful in such way that it would avoid Drop box (knowledge sharing tool) but still it doesn’t support collaboration (multi user editing). Complex problem are solved through series of steps and wiki can be a part of it. Only wiki can’t be used to solve complex problems.”

(Software Engineer, Folio3, Karachi office)

One of the developer commented that wiki could helpful in solving the complex problem but in restricted and limited way, he commented that

“... It can helpful but in a very little way because complex problems are always unique and they are different from what has already been solved”.

(Database Architect/ developer, Folio3 Karachi office)

Developers pointed out that they arrange meeting and bring all the people on same page through wiki. Developer completes initial step with feedback form. People who are interested in addressing problems and related ideas could be identified with the help of wiki and hence wiki could also minimize people and time through this activity.

Wiki itself is supporting tool for solving complex problem in learning organization, Chief technical officer in USA folio3 added ,

“... Yes it can help; if everyone starts posting this information on the wiki then it will help in learning things pretty quickly. People do not need to go through the internet to figure out everything. They can read about it on the local wiki and then talk to the person who already solved it earlier”.

(CTO, Folio3 USA office)

Developer commented that through knowledge sharing and its accessibility, wiki provides help to solve the complex problem in organization.

“.... Yes through knowledge sharing and accessibility”.

(Software Architecture, Folio3 Karachi office)


5. Empirical Findings Detail and Results

In this fifth chapter we discussed the empirical findings based on research work. We have highlighted quotations from concise summary of interviews as well as detailed analysis of interview performed. Our empirical findings and results are divided into three forms, we analyzed how wiki provide its support in knowledge conversion model presented by Nonaka and Takeuchi, and later we discussed about new knowledge creation in virtual organization learning and complex problem solving in distributed software development process.

5.1 Socialization Mode

The first question we asked was about sharing of organizational knowledge available in mind of employees. In the question we focused on, how do employees come in action during sharing of organizational knowledge. After getting answers from developers we came into conclusion that, most of the developers share the tacit knowledge during software development practice. During interview some of the developers expanded their answer that training session was perfect time for them to share the knowledge.

The other question we asked developers was related to the effectiveness of wiki tool during the sharing of the tacit knowledge. Most of the developer’s agreed upon its effectiveness of wiki tool. Few developers told us that use of wiki in an organization helps in making knowledge folders or knowledge maps which could be further used in forms of booklets and directories. The answers we got from developers clearly shows that developers are interested in the use of wiki bringing knowledge maps in action.

From the second questions in socialization mode. We came in conclusion that developers enjoy sharing of organizational tacit knowledge in training session and as well as software development practice. Those answers, as described by developers let us confirm that training session and software development process is good platform for sharing of organizational tacit knowledge. Similarly, developers were aware of wiki and its effectiveness during software development process. It builds up confidence in making knowledge specialized folders which can be used further. We concluded that wiki in socialization mode can increase the effectiveness as most of developers use wiki tool from different perspective like sharing of videos and pictures directly. We also concluded that platform available in wiki makes developer easy in using required topics.

5.2 Externalization Mode

This is the second mode that we have analyzed. Couple of questions were asked with the developers. With questions asked with the developers, we wanted to know, how knowledge is captured for organizational process, the effectiveness of wiki in capturing knowledge and as well as wiki’s help in structured or unstructured knowledge content.

Going with first question about capturing organizational knowledge. The developers have their mixed view in this question during interview. Similarly, some commented that knowledge is captured with help of social interaction. Some of the developers think that knowledge captured
can be done in manual process. On the other hand, developers do have the perception about social media tool for capturing of knowledge.

The second question in externalization mode was related to the effectiveness of wiki in capturing knowledge. Developers believe in effectiveness of wiki during knowledge capturing process. The answers by developers showed that wiki was helpful in capturing as developers answer that training exercises will be uploaded in wiki which further helps in consolidation of all the information. Developers have very high confidence and they believe that wiki allows them to work them effectively. It was also known that some of the developers believe in manual process despite its time consumption.

In the last question of this externalization mode, developers were asked about structured and unstructured knowledge content with the help of wiki. Many developers agree on behalf of their experience. The answers showed that developers use wiki for proper structure of knowledge content as one of developer told “People create new pages and move data around so it is always structured correctly”. On the other hand, going through other answers, it showed us that wiki support structured knowledge content through the performing three different roles of knowledge sharing. Few, developer’s answers showed that, uploading the articles is easy in the wiki, either it is structured or unstructured.

From the answers given by developers we could see that wiki helps in capturing of knowledge for an organizational process. In the same way, wiki makes work effective and as well as make structured or unstructured knowledge content available. The detailed information could be collected, and shared either it is in structured or unstructured form, in an understanding way. One of the developers told us that “People can submit a lot of knowledge and moderators set them properly”.

5.3 Combination Mode

Combination is the other mode of Nonaka and Takeuchi (1995). From this mode we are trying to understand how developers transformed explicit knowledge into more complex forms with the help of wiki.

The first question we asked with developers in this mode was related to knowledge codification in distributed software development. Many of the developers agreed that wiki is helpful in codifying knowledge as wiki contains different tags, keywords and phrases. The searching capacity of wiki takes less time for finding relevant information. The answers showed that developers rely on use of wiki, because of good available option to handle the documents.

The second question we asked was about the uses of wiki for knowledge accuracy and also about update of information in distributed software development environment. Few of developers explain that accuracy of knowledge depends upon administrator and owners, who are responsible for managing contents. Most of the developers are satisfied saying that accurate contents available in wiki helps in reducing confusions. Further one of the developer added that wiki investigation helps for accurate knowledge. We found that accuracy of organizational knowledge through knowledge content was supported by wiki. From the developers, it was also found that the use of
wiki supports organization for making knowledge up to date. Developers added that with the help of wiki tool, different volunteer helps in making information up to date so that other people can use it. We found that with the help of wiki, the users can share the accurate information and make it up to date.

The third question we asked to developers was related about managing and organizing knowledge as we asked them how does wiki helps in managing and organizing knowledge effectively. Except few developers, many of them agreed that the wiki helps in organizing and managing the documents with the help of different options available in the wiki. We found that with the help of wiki, different knowledge is collected as well as organized and used further. We also discovered that, developers use wiki as platform for discussion of different topics in organized form.

The fourth question was related to the reuse of knowledge. We are trying to find out the use of wiki for the reuse of knowledge and we asked developers how do wiki helps in reuse of knowledge. In the first question, developers replied positively. We came to know that wiki saves a lot of time when stored knowledge has been re-used. Developers agreed on saying that they search in wiki and use contents for solving problem. In the same way, some of the developers argue saying that knowledge that is driven from existing base is really good and helpful during work process. Further, developers added that recycle of knowledge helps in utilizing of knowledge for specific purpose.

In other sub question, we asked them if stored knowledge is applicable for reuse through wiki or not. The developers agreed on saying that wiki is most helpful in that purpose. We came to know that developers are fully using wiki, for reuse of knowledge which is stored and pointed towards maximum utilization of stored knowledge. Further they added, wiki is applicable in reusing knowledge and it can be used for use of existing knowledge for further enhancement and conclusion.

5.4 Internalization

The question in internalization mode was asked as it helps in incarnating explicit knowledge into tacit knowledge. Following this mode of knowledge conversion we asked with developers that if wiki promotes generation of new knowledge through internalization process. According to answers we got from developers, most of the developers agree that wiki allows users to create knowledge content. One of the developers added that, knowledge content is helpful in promoting and generating knowledge. We found that majority of developers perform knowledge sharing through specific section of knowledge with the help of wiki. In the internalization mode developers in the distributed environment spoke in favor that wiki helps in creation and promoting of new knowledge and impression is positive. Some of the developers were concerned about created knowledge if it is applicable for other members or not.

On the other hand, in second part of question we asked if they took help from wiki for searching relevant knowledge. Developers explain that wiki contains key words and phrases, and they have to rely upon them which are a big problem. The other answers showed us that developers have problem in different terminologies that is available in wiki which refers two or more areas of concern.
5.5 Wiki for New Knowledge in DSDP

In this portion we try to know about the role that wiki plays while gaining and creating new knowledge and as well as role of wiki in learning and training purpose. In first question we asked developers about creating and gaining new knowledge. In this question, except few developers many of them support on saying that wiki helps in gaining new knowledge. Further other developers added that with organized means of email, employees in organization get useful information and gain knowledge. The support of developers on use of wiki for purpose of gaining and creating knowledge was in high. Similarly for the usage of knowledge through wiki, developers replied that availability of tools in wiki helps in applying new knowledge. They added that content available in wiki also makes work easy for applying purpose. The flexibility of wiki tools makes us apply knowledge, Developers added. We came to know that tools and techniques that are provided by wiki make work easy and perform the work. Developers focus on categorizing of stuff on the basis of subjects.

In the second question about accessibility of created new knowledge through wiki, developers pointed and agreed saying that wiki makes it accessible through the use over internet and intranet. With the help of reference in appropriate places wiki makes created new knowledge accessible, we concluded.

5.6 Wiki for Virtual Organization Learning

Two questions were asked in this part, first it was asked to know how learning took place in virtual organization. Similarly we were keen to know about the usefulness of wiki in learning process in an organization. Most of developers agreed on saying that learning took place in an organization with the help of wiki. In this virtual organization, we came into conclusion that learning is possible through sharing of knowledge through emails as well as portal or wiki, developers added. In the other way developers told us that different process is available in an organization for learning. We came to know that occurrence of learning provide help for the junior staffs.

In other question about the helpfulness of wiki in learning process, all developers are positive that wiki supports and plays role. This is because of high effort and support of senior staffs. We came into conclusion that precious knowledge available in wiki can be useful to working staffs deployed in organization. The document updated is also another way through which developers learn, another developer added. Different suggestion came out as developers stated their views on their own way. Identification of problems, starting with different solutions, idea sharing and getting the feedback is the suggestion, we concluded. Similarly in process of explaining learning through wiki, developers agreed and added, just a search and a single click to results are really helpful.
5.7 Wiki for Complex Problem in Virtual Learning Organization

This part is concerned with solving complex problem in a virtual organization through wiki. In the second part of question, it is concerned about help of wiki in solving complexity of problem in learning.

In first question developers told that if some complexity is seen in virtual team they start with immediate action like, calling group persons, presenting different agenda and many more steps. We came to know that only main idea to solve complex problem is to go with immediate action. Some of the other developers in organization state that complexity of problem is solved through different types of research and analysis. We can gain knowledge through experience, imitation, participation and different observation, one of developers added. Similarly developers spoke complex problem is solved with taking solution with team and implement on wiki so that all developers can have access. Only few developers suggest that complexity of problems can be solved with the process of maintain word documents and sharing document with other members.

In second question, Most of the developers agreed upon saying that wiki helps in solving complex problems and help in learning process in virtual organization as different knowledge is saved in wiki. We concluded that saved information can be taken as knowledge where junior and senior employees in distributed system can utilize. Developers added on saying that uploaded articles and documents can be seen in wiki and used. Except few developers, other commented in a positive way to the usefulness of wiki in dispersed location saying information is posted in which developers can learn quickly. We believe in knowledge sharing and accessibility of knowledge through use of wiki, another develop added.
6. Analysis & End Discussion

In the sixth chapter of this dissertation we discuss and examine the result findings that we got from the interviews with the help of literature review explained in second chapter. The chapter helps us to discuss the answers from our designated research questions.

The research that we have conducted in global knowledge management area has informed us how tacit and explicit organization knowledge plays a meaningful role in distributed software development process (DSDP). Due to globalized nature of IT industry, organization needs to focus on remote team communication, performance and outcomes. Companies require focus on technological development and infrastructure for securing information in distributed software development process which is possible through use of technological tool.

6.1 Global Knowledge Management Support in DSDP

Due to technological advancement in IT, Global software industry becomes crucial part of business where importance of knowledge creation and sharing plays an important role. Domain, contextual and specialized organization knowledge play a important part in knowledge based economy. In knowledge based economy knowledge is continuously shared, created and integrated for avoiding business obsolescence in virtual scenario. Thus, it helps in improving performance of team’s communication and get desired outcome (Samarah et al., 2007). The company (folio3) in which we conducted our research was looking a global knowledge management support where shared and dispersed knowledge could be managed, integrated for generating, creating and innovating purpose in distributed software development process.

6.2 Virtual Organization Learning

The major concern for folio3 employees was dispersed location and get connection with employees in distributed environment for sharing different activities in the process. The problem arises when there is, no face to face communication between employees. With answers we got in our interviews with employees, they could used wiki for creation of new knowledge as well as solve complex problem. We try to analyze that tool could be better option for solving those problems that was in virtual organization learning.

6.3 Knowledge Conversion Model in DSDP

This research was carried out for an interest in uses of wiki in different perspective in distributed software development organization. The study examines on uses of wiki for creating and learning in between employees which is based on distributed area. It adds in the role that wiki plays in the virtual learning organization and also the usage of wiki in solving different complex problem. The analysis was based on knowledge Conversion Model of Nonaka and Takeuchi (1995). This Nonaka and Takeuchi (1995) Knowledge conversion Model gives explanation about the transformation of knowledge that is available in tacit and explicit form. This model helps in
transforming different knowledge among people. With the use of this model, we came to know about possibility of interaction among employees for creating, learning, re using and many more. Further wiki’s influence in the certain modes was known. Based on this mode, interaction among employees with the help of wiki tool was also identified.

**Socialization process:**

Tacit knowledge is created from other tacit knowledge in *socialization* mode of Nonaka’s and Takeuchi (1995) knowledge conversion model. We found that tacit knowledge is shared among employees during software practice. The employees around organization have different types of training during the process which becomes the mode of sharing tacit knowledge in an organization. During training session in an organization developers get great opportunity to share and learn with the help of interaction. With answers we got from developers, we were able to analyze that sharing of tacit knowledge is possible through social and mutual interaction.

Finally we analyzed that wiki didn’t support and play important role in socialization mode, as according to claim of Volkel and Oren (2006, p.3) *socialization is often not an option in online environments*. Nonaka and Takeuchi (1995) claimed in their model that socialization occurs only when individuals interact to other individual and share experiences that is resided and revolves in their mind.

Therefore we assume possibility of wiki’s use for social interaction and collaboration in virtual organization learning. The possibility and chances seem to be minimum because distributed natures of employee rely on wiki tool and want to share experiences of organization knowledge without social interaction to each other.

**Wiki for sharing tacit organizational knowledge**

We discovered in our interviews that most of developer share organizational tacit knowledge with the help of wiki setup, specialized knowledge folders and knowledge maps, video, audio text. Few developers answered that wiki supports socialization and is able to provide logical answer in terms of explanation in real concept of socialization through wiki tool. They explained us that they share tacit knowledge through wiki tool in terms of knowledge maps or folders, images, videos and audio files.

**Externalization process:**

The externalization mode consists of transforming tacit knowledge into form of explicit knowledge (Nonaka and Takeuchi, 1995). It is also called ‘Process of Articulating’. Wiki in the distributed environment was useful in this mode as it helps developers in the virtual environment to share their knowledge. Wiki in this mode helps in externalizing knowledge. In this mode of knowledge conversion, capturing of knowledge is also possible by means of collective intelligence and through different valuable sources.
Wiki for support of knowledge capturing

According to claim of (Chatti et al., 2007; Sousa et al., 2010; O’Leary, 2008) wiki is helpful tool especially for capturing tacit knowledge and publishing their work through collective intelligence. It is also helpful in converting purpose of tacit to explicit knowledge with help of some functionality which includes adding knowledge content to new and existing pages and writing comments on existing pages. Wiki users have access to this profile page for keeping their contacts, specialties, organizational assets and utility related to project portfolio as well as knowledge concerned to business.

Nonaka and Takeuchi (1995) claimed that externalization is the process of articulating tacit knowledge in to the explicit concepts. With means of different types of analogies, metaphors, models and the hypothesis, the tacit knowledge becomes explicit.

The wiki was helpful for the developers as it helps in sharing the knowledge. Similarly, we came to know that wiki plays effective role in the process of capturing knowledge. Developers rely upon training exercise. The wiki helps them to load training exercise and consolidate information in which developers rely upon. With the help of adding pages, developers provide fast way to have concern and get feedback. With that idea, we came to know that developers can utilize knowledge they gained, and helps in making the decision.

Wiki for support of structured and unstructured knowledge content

According to (Oren et al., 2006; Schaffert et al., 2008; Solis & Ali, 2010) Wiki supports structured and unstructured knowledge content such as annotations and linking of web pages. The developers created the new pages for organizing the different index and the links. The different links helps them to move data around in structured way. We came to know that developers rely upon these activities because; it is easy for the developers to get access for the well structured format of knowledge. Taking answers from developers, we also came to know and concluded that the created page is really helpful in managing structured knowledge content with wiki. The wiki was helpful there because the contents were kept in created page which was in the individual’s mind. Finally we also discovered that wiki did not have good support in terms of unstructured knowledge content.

Combination process:

The process of converting explicit knowledge in to more sets of explicit knowledge takes place or occurs in the combination mode of Nonaka and Takeuchi (1995). The answers we got in this mode helps us in understanding how explicit knowledge is converted and combined with the help of wiki.

According to Nonaka and Takeuchi (1995) combination is the process of reconfiguration including the process like sorting, adding, re-contextualizing etc, and return as a new form of complex explicit knowledge.
Wiki for knowledge codification:

According to (King, 2006) wiki is a kind of tool to provide option for editing the existing codified knowledge that may lead towards maintenance issues and problems of repositories as well as provide option to update knowledge anytime.

We evaluate that wiki do have ability to categorize knowledge separately on various domain during process of codifying knowledge but it was very hard to identify right tags and keywords to search right knowledge content. We also found that problem occurred while codifying knowledge. When wiki supports terminologies in more than two area of study and divide information as per the term, it is beneficial for better searches and results as well as better utilization of codified knowledge.

Wiki for managing and organizing knowledge:

Majchrzak (2006) argues that combination process supports and author explains that wiki can be helpful through wiki group contributors: synthesizers and adders. First, groups have responsibility in adding new knowledge content and second group have responsible in rearranging, managing and organizing existing knowledge which is posted by administrator on existing pages. Later on user have option to reorganizing set of pages, rewriting whole paragraphs and roll back other writings.

After analyzing interviews from developers, we came in the point that, combination mode allows developers to express different types of views with the help of wiki. We came to know that wiki is a helpful tool for combination process because developers in virtual team add their contents or documents to make them available for all. In other end, developer uses this knowledge content for rearranging, managing and organizing purpose. We also noticed that wiki is very supportive tool in terms of managing and organizing knowledge with the help of different wiki pages, index pages and searching content. The wiki materials are organized with the help of those created pages.

Wiki for knowledge accuracy and updating:

According to (locker, 2006) wiki can be easily updated by any of the persons in an organization. Different wide range documents of company like guidelines, FAQs (Frequently asked question) are more easily kept with accuracy.

We came to the point that wiki does supports knowledge accuracy and updating in very low degree because we got the answers that wiki does not provide full satisfaction for developer in terms of accuracy and updating of knowledge. However administrator and moderator perform manual job for handling accuracy and updating of knowledge. Finally majority of developer agreed that wiki is best tool for combination process despite some problems regarding accuracy and keeping knowledge up to date. This tool needs volunteer effort for updating anything in the system.
Wiki for knowledge reuse:

According to (wager, 2005) in virtual team organization wiki may support knowledge sharing and reuse as well as knowledge shaping. Another assumption, we evaluated that wiki become supportive tool regarding re-usability of knowledge through utilization of existing knowledge bases and by using proper intelligent search system. The proper intelligent search system provides help for developer to reuse knowledge efficiently in an effective way.

Internalization process:

The internalization mode in knowledge conversion of Nonaka and Takeuchi (1995) helps incarnating the explicit knowledge into tacit knowledge. In this mode of knowledge conversion we found that there is opportunity to learn new kind of knowledge and use them for further innovation in organization. According to claim of Nonaka and Takeuchi (1995) internalization requires an individual to identify the relevant knowledge that belongs to him/her.

Wiki for searching relevant knowledge for specific individual:

According to (Sousa et al., 2010) Individual wiki user use available externalized knowledge for internalization purpose for identification of relevant subject problems, procedures and project knowledge. The developer explained many advantages of wiki uses; they said that wiki provides specific sub section which is helpful for identification of the projects. We found the drawbacks in wiki which relates to problem that developers face regarding the identification of the relevant knowledge at the right time and in a right place. Wiki is not capable in searching the relevant knowledge when it is necessary in the right time for utilization.

Wiki promote generation of new knowledge:

According to (Sousa et al., 2010) Wiki consist of choice to generate knowledge content for linking it to other content by using hyperlinks. During this mode of internalization, developers use knowledge content for the generation of new knowledge which is helpful in promotion We came to know that it is possible through the use of hyperlinks, images and text. It is also discovered that knowledge content is helpful in promoting new knowledge in organization.

Wiki was crucial for internalization process as it creates different knowledge section or subsection for the project. Hence wiki becomes helpful for generation and promotion of new knowledge. Nonaka and Takeuchi, 1995) knowledge conversion is the collaborative process which expands the quality and quantity of knowledge which is in explicit and tacit form.

6.4 Wiki for Creating New Knowledge in DSDP

According to (Cress & Kimmerle, 2008; Sousa et al., 2010) wiki is supportive tool for creation of new knowledge as well as wiki supports innovating process. We came to know this stage after

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analyzing the interview we took from developer. Wiki tool have good options available to support new knowledge creation as well as knowledge building. We came to know that that tool consists of flexible option for developer to create new knowledge which is possible with mutual interaction and understanding. It does not allow to rely on bookish information stored in the tool. Due to this, wiki can be helpful in creating new knowledge with the help of tool functionalities and functions.

6.5 Wiki for Virtual Organization Learning

(Coutinho & Bottentuit, 2007) explains that wiki plays a crucial role in virtual learning organization and learning environment. The role is specially use for collaboration and cooperation purpose in an organization. We examined that wiki plays a crucial role for virtual organization learning through the different sources that is available in wiki. The different source includes, document uploading facility, sufficient availability of deployment space for knowledge, larger accessibility for keeping up to date findings and research of employees, searching facility to find million of stuff along with most appropriate link.

6.6 Complex Problem Solving in Virtual Organization Learning

According to (Yu et al., 2007) people generate knowledge which is helpful in solving job related complex problem for organizational benefit and organizational improvement. After conducting interviews with developer we found complexity in virtual team. They commence immediate action like phoning to concerned person, demonstrating different agenda and making more steps which helps to solve complexity. We also found that wiki tool was much helpful in solving complex problem in virtual organization learning.

Wiki for complex problem solving on virtual organization learning:
According to (Sousa et al., 2010; kimmerle et al., 2011) wiki provide help in solving complex problem task in virtual organization learning. After taking interviews with developers we came to know that wiki is the best tool for solving complex problem in virtual learning organization. Wiki has characteristics to bring together all employees on a shared page where dispersed employees share their experiences and discuss complex problem task during virtual meeting. Feedback form in wiki provides platform for developer who addresses problem related issues and figure out through series of steps which would be effective for solving complex problem. After these facts, we could say that wiki have much space for solving these kinds of complex problems that usually arose in organization.
7. End Results & Conclusion

The final seventh chapter of this dissertation consists of end results and conclusions through responses of our research question. This includes recommendation for the organization where we conducted this study. Finally, we try to explain the future research which can be conducted in globally distributed organization.

Our research focus on distributed nature of software organization where interconnection, communication is required in exchanging of knowledge among employees. Wiki as a knowledge management tool is possible for providing effective as well as efficient communication as per necessity of knowledge requirement in an organization. Use of wiki in organization for virtual learning, knowledge creation purpose as well as solving complex problem is really beneficial for obtaining useful effect on virtual team performance, team coordination and outcomes. The answers to our research question are as below.

How does wikis support four mode of knowledge conversion process (SECI) in DSDP?

We highlighted our research question by using knowledge conversion model of Nonaka and Takeuchi (1995). We focus on each mode of Nonaka that includes Socialization, externalization, combination and internalization. In each section we discussed that wiki supports knowledge conversion process in DSDP environment.

In socialization mode, we analyzed that wiki did not support knowledge conversion process in terms of sharing organizational tacit knowledge. Wiki was not perceived as useful tool by developer, afterwards most of organizational knowledge sharing during this mode is accomplished by the help of training sessions and social interaction between developers. After all developer used knowledge folders or maps, video, images, text for sharing tacit knowledge among employees located across the boundary. Wiki is not the best tool which supports to share organizational tacit knowledge resided in individual mind.

Moving towards externalization, the developer become conscious and spoke that wiki is a well-supported tool for capturing knowledge during conversion of tacit to explicit form because social interaction, collaborative act of work and involvement of collective intelligence is required at the time of knowledge capturing. Wiki tool is helpful during knowledge capturing by allowing developers to upload the training exercises and materials which are relevant to project details. Wiki consist the functions to capture the knowledge through creating new pages, with making indexes, with developing page links and drawing bookmarks.

Concerning to the combination mode, the developers evaluated that wiki has ability to categorize knowledge as separately on various domain during codifying knowledge but it was very hard to identify the right tags and keywords to search the right knowledge content. Another assumption
developer have is that wiki tool was not helpful for knowledge accuracy because it depends on the responsibility of administrator or owner who administered the content. Additionally, wiki is a supportable tool for knowledge updating because it has options and features available to check and verify the updated knowledge through features for identifying the sources. Finally developers have perception that wiki is valuable tool for knowledge reuse purpose in software organization. It is with the help of intelligent search system and existing knowledge bases.

The internalization mode converts explicit knowledge into tacit knowledge form and also it requires individual to identify knowledge that is relevant to them (Nonaka and Takeuchi, 1995). In this way wiki has option for developer to identify the project specific knowledge through authentic source of knowledge content. Specific knowledge section and stub is also helpful for developer who can generate and promote new knowledge in distributed environment.

**How does wiki helps in creation of new knowledge?**

We analyzed the answer on the basis of externalization and combination mode where tacit knowledge becomes explicit and explicit get more in simplified form. Creation of new knowledge occurs in the distributed software development process when developers share and codify the contextual organization knowledge through wiki to others for learning and training purpose. Knowledge that developers share is new for others and thus knowledge is created. However developers notice that wiki is helpful tool for creating new knowledge but in restricted manner. It depends on knowledge creator who arranges and categorizes knowledge on the basis of references and proper places. Dependency on bookish information is demotivated.

**How wiki does support virtual organization learning?**

Wiki as a knowledge management tool and a social media was found to be used in a support of organizational learning. Wiki does support the virtual organizational learning. Most of the learning took place in an organization with the help of wiki, as it makes sharing of knowledge possible through the use of wiki.

In this virtual organization, we got answer that learning is possible through sharing of knowledge through emails as well as the portal. In the other way wiki as a tool helps in different process and is available in an organization for learning. We came to know that occurrence of learning provide the help for junior staffs.

Wiki helps in learning process in a virtual organization. Wiki supports and plays the role. This is because of the high effort and support of senior staffs. The senior staff’s role in a virtual organization is most important and significant for organization. We came in to conclusion that precious knowledge available in wiki can be useful to the working staffs deployed in organization. The document updated is also another way through which developers learn, the wiki also helps in identification of problems, starting with different solutions, idea sharing. We are able to analyze that the junior and the senior staffs are available for the sharing of the knowledge in the virtual team.
How does wiki helps in solving the complex problem in virtual organization learning?

We got answers from developers that if some complexity is seen in virtual team they start with immediate action like, calling the group persons, presenting different agenda and many more steps. We came to know that only main idea to solve the complex problem is to go with the immediate action for solving complexity of problem. We analyzed that developers in organization explain that complexity of problem is solved through the different types of research and analysis. Wiki helps in solving complexity of problems with the help of knowledge through experience, imitation, participation and different observation, one of the developers added. The complexity of problem is solved with speaking with developers because developers play role in tackling the problems. In the same way, complexity of problems can be solved with the process of maintaining word documents and sharing documents with other members.

We got answers from the developers that wiki helps in solving complex problems and help in learning process in virtual organization as the different knowledge is saved in wiki with the help of which developers can use it. We concluded that the saved information can be taken as knowledge where junior and senior employees in distributed system can utilize. With the help of wiki uploaded articles and documents can be seen in the wiki and used for solving complexity of problems. We analyze that usefulness of wiki in dispersed location saying information is posted in which developers can learn quickly which also helps in solving problems which is complex.

7.1 Outcomes

The research that we have conducted in the global knowledge management area has explained the role of tacit and explicit knowledge in distributed software development process and we have evaluated that wiki as knowledge management tool also plays a crucial role in Global knowledge management area especially global IT industry where remote team coordination, communication, performance and outcomes was in focused.

We noticed that wiki plays an important role in global knowledge management. The shared knowledge is created, integrated, managed, generated as well as used for innovating purpose in distributed software development process. Wiki is best tool for supporting knowledge conversion process model of Nonaka in terms of distributed software development process. It provides help in new knowledge creation and virtual organization learning practices. Finally we came to know wiki was supportable tool for complex problem solving but in restricted manner. It solves complex problem in a restricted manner because it does not have enough intelligent support along with multi user collaborative facility to bring people on the same page for solving the common task.

Three drawbacks and weaknesses that we have noticed are as below.

- Wiki has problem in openness, genuineness, authenticity, trustworthiness, accurateness and uniqueness of knowledge content.
- Wiki can be easily written, edited and published the work without intervening administrator supervision and approval.
• Through wiki, developers are not able to identify the right tags and keywords during search the right knowledge content at the right time and at the right place.

### 7.2 Future Research

The research was conducted in Folio3 organization. It shows the results that could be applicable for other software development organization in disperse location and deal all matters remotely including requirement analysis, requirement gathering and project documentation through intermediated ICT technology where face to face communication chances is very low. The utilization of wiki in distributed software development process as a global knowledge management perspective can be explored and make platform for global customer who rely upon their business needs and outcomes across the boundaries.

Further research can be conducted on quantitative study in which organization can decide on proven results and findings that wiki as global management tool. Different kind of hypothesis and test results may be more helpful for organization in making decision and favor to organization.

Additional more research can be executed in term that wiki is commonly and adequately used in organization for transferring knowledge and sharing purpose. It is seen that that organization often use that tool only for strategic purpose to improve business goals and outcomes but in long run the tools consist of back doors due to openness nature which is harmful for security. The openness nature of wiki brings threat for leakage of sensitive information in business organization. The openness nature of wiki brings typical problems as well. In Future the research can be conducted to minimize the openness nature of wiki and have some implementation to hide openness.
References


Appendices

Appendix A - Interview Questions

Socialization

1. How do you share the organizational tacit knowledge that is in your mind during DSDP?

2. Is wiki effective to support organizational tacit knowledge during socialization process?

Externalization

1. How do you capture the organizational knowledge during DSDP?

2. Is wiki effective in capturing the knowledge during the work process? If yes then how.

3. Does wiki support structured or unstructured knowledge content during the time of knowledge capturing?

Combination

1. What are the problems you often face while codifying organizational knowledge during DSDP?

2. How does wiki support for keeping organization knowledge up to date and accurate? If yes then how.

3. Why is it necessary to consider the wiki for data accuracy?

4. What do you think if wiki can be helpful for managing and organization knowledge in an efficient manner?

5. How does wiki support reuse of knowledge in DSDP? If yes then how?

6. What do you think that if stored knowledge is applicable for reuse?

Internalization

1. How wiki does promote generation of new knowledge through internalization in DSDP?
2. Is wiki helpful for searching relevant knowledge that belong to specific person?

Wiki for new knowledge in DSDP

1. How do you create and apply new knowledge through wiki in DSDP?

2. What do you think that creating new knowledge with the help of wiki is accessible or not? if accessible then how.

Wiki for virtual organization learning

1. How does virtual organization learning take place in DSDP?

2. Do you think that wiki can be helpful in virtual organization learning within the virtual team? If yes then how. What about your perception regarding wiki in organization learning in DSDP?

Wiki for complex problem on virtual organization learning

1. How do you solve the complex problem in DSDP?

2. What about your perception regarding wiki can be helpful for solving complex problem in DSDP?

Appendix B - Interview Answers

<table>
<thead>
<tr>
<th>Interview Questions</th>
<th>Chief Technology Officer (CTO)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How do you share the organizational tacit knowledge that is in your mind during DSDP?</td>
<td>I prefer discussion in the training session so that knowledge can be shared.</td>
</tr>
<tr>
<td>2. Is wiki effective to support organizational tacit knowledge during socialization process?</td>
<td>Yes, I think that wiki is effective in support of organization knowledge with the help of gathering.</td>
</tr>
<tr>
<td>3. How do you capture the organizational knowledge during DSDP?</td>
<td>Knowledge capturing is not possible without social interaction in the organization</td>
</tr>
<tr>
<td>4. Is wiki be effective in Capturing the knowledge during the work process? If yes then how.</td>
<td>Yes, wiki is a very effective tool in knowledge capturing process.</td>
</tr>
<tr>
<td>5. Does wiki support structured or unstructured knowledge content during the time of</td>
<td>Yes, perform through different roles of knowledge sharing including knowledge sharing.</td>
</tr>
<tr>
<td>Knowledge capturing?</td>
<td>Producer, knowledge intermediary, and knowledge consumer.</td>
</tr>
<tr>
<td>----------------------</td>
<td>---------------------------------------------------------</td>
</tr>
<tr>
<td>6. What are the problems you often face while codifying the organizational knowledge during DSDP?</td>
<td>Wiki is one of the best tools that allow us to share information among team members. It comes up with the right set of tools that allow you too easily [codify the knowledge].</td>
</tr>
<tr>
<td>7. How does wiki support for keeping organization knowledge up to date and accurate? If yes then how</td>
<td>I don’t think there is such support in wiki tools about accuracy, so it can be implemented or it is up to the owners who are responsible to the content.</td>
</tr>
<tr>
<td>8. Why is it necessary to have considered the wiki for data accuracy?</td>
<td>Wiki has ability to revert the older version of knowledge if we found that saved knowledge is not useful in software development process.</td>
</tr>
<tr>
<td>9. What do you think that wiki can be helpful for managing and organization knowledge in an efficient manner?</td>
<td>We could manage the different topics/subjects/departmental stuff in separate folders.</td>
</tr>
<tr>
<td>10. How does wiki support reuse of knowledge in DSDP? If yes then how</td>
<td>Sometimes the information gets old. When the information is still valid, its helps saving a lot of time from [reuse].</td>
</tr>
<tr>
<td>11. What do you think that if stored knowledge is applicable for reuse?</td>
<td>I think so, wiki can be supportive tool in term of stored knowledge utilize for reuse purpose.</td>
</tr>
<tr>
<td>12. How does wiki promotes generation of new knowledge through internalization in DSDP?</td>
<td>We can develop our own mixed, edited and synthesize project specific knowledge content within a shared digital artifact by the help of wiki.</td>
</tr>
<tr>
<td>13. Is wiki be helpful for searching relevant knowledge that is belong to specific individual</td>
<td>No, it requires lot of improvements and management.</td>
</tr>
<tr>
<td>14. How do you create and apply new knowledge through wiki in DSDP</td>
<td>I don’t prefer wiki for new knowledge rather I use multiple resources.</td>
</tr>
<tr>
<td>15. What do you think that creating new knowledge with the help of wiki is accessible or not? If accessible then how</td>
<td>It can be accessible within the organization over the internet, intranet and shared places.</td>
</tr>
<tr>
<td>16. How does virtual organization learning take place in DSDP?</td>
<td>Learning take place in virtual organization through presentation, training session, conducting seminars, sharing knowledge through emails, letting personnel’s learn a given syllabus and implementing an internal portal/wiki and also take place when people get on new targets and research about them.</td>
</tr>
<tr>
<td>17. Do you think that wiki can be helpful in virtual organization learning within the virtual</td>
<td>• Identifying problems</td>
</tr>
</tbody>
</table>
18. How do you solve the complex problem in DSDP?  

The problem & then solution is speech out on word document shared through Dropbox, discussed in person/conference call and then implemented.

19. What about your perception regarding wiki can be helpful for solving complex problem in DSDP?  

Yes. It can help; if everyone starts posting this information on the wiki then it will help in learning things pretty quickly. People will not require in going through the internet to figure out everything. They can read about it on the local wiki and then talk to the person who had solved it earlier.

<table>
<thead>
<tr>
<th>Project Manager / Direct Technology</th>
<th>Software Architecture</th>
</tr>
</thead>
<tbody>
<tr>
<td>I choose internet / wiki portals for sharing organization tacit knowledge.</td>
<td>We prefer to share knowledge over email.</td>
</tr>
<tr>
<td>Yes, We can manage through different Topics/subjects/departmental stuff in separate folders. The wiki provides editing of shortcuts on main page (dashboard), adding favorite links in menus, recently added material links, and recently surfed links by user etc.</td>
<td>We have wiki setup or specialized knowledge folders for all the different areas of the Organization. So e.g. we have a site for HR another for Admin &amp; operations and others for the technical areas of knowledge.</td>
</tr>
<tr>
<td>We mostly capture the knowledge through manual process and it takes a lot of time consume during capturing.</td>
<td>Knowledge capturing is not possible without collaborative act of work.</td>
</tr>
<tr>
<td>No, wiki is not effective tool for knowledge capturing purpose because all process is done by manual work and it takes lot of time to consollidate information.</td>
<td>Yes, If we need to have feedback on some topics or any other news for the work. Simple adding new pages with options to write provide fastest way to have concerns and feedback with many employees. We can further utilize that information for making decisions and other use.</td>
</tr>
<tr>
<td>Yes , People can submit a lot of knowledge and moderators set them properly</td>
<td>You can have a page where you can put down everything you have in mind. Later on you can extract whatever is important and put it in a single correct place.</td>
</tr>
<tr>
<td>The problem is that people keep on adding information to the wiki. You have to rely on the correct keywords to find out the right</td>
<td>Its informal, it’s very difficult to organize knowledge in it.</td>
</tr>
<tr>
<td>content. Coding does not really help here</td>
<td>Wiki investigation of content helps the {accuracy of knowledge}&quot;.</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>---------------------------------------------------------------------</td>
</tr>
<tr>
<td>Since wiki is a central location which consist of updated information, it helps us reducing confusion about information and knowledge</td>
<td>central people can edit it. Developer can revert back easily to an older version.</td>
</tr>
<tr>
<td>Without knowledge accuracy we cannot rely on existed knowledge is applicable for product improvement.</td>
<td>We have different wiki pages for all organization areas, meanwhile we able to [organize it] in a proper way.</td>
</tr>
<tr>
<td>We have different wiki pages for all organization areas, meanwhile we able to [organize it] in a proper way.</td>
<td>Mostly through comments kept in by people in wiki tool and we [discuss] them about.</td>
</tr>
<tr>
<td>You can search the right content and then use it to solve your problems.</td>
<td>We have option to utilize the existing knowledge base for the reuse knowledge purpose into the software development activities</td>
</tr>
<tr>
<td>Stored knowledge in wiki is always meaning full for organization because we take decisions on the basis of knowledge that is to stored and available for reuse.</td>
<td>Definitely, reuse knowledge is applicable in terms as developer extract new ideas from existing knowledge that was stored in the wiki tool.</td>
</tr>
<tr>
<td>We can connect the knowledge content to other knowledge content with the help of hyperlinks, images and text then generation of new knowledge happened easily in a collaborative way of fashion.</td>
<td>In wiki, we create specific knowledge section or stub related to our business project knowledge, later on other members who are located in different region can be able to add their content as freely</td>
</tr>
<tr>
<td>No, wiki does not support to identify the right tags and keywords.</td>
<td>I don’t think wiki support it because it is very far away from basic level of formatting.</td>
</tr>
<tr>
<td>People who solve a problem keep on the wiki, it help us gaining new knowledge. Similarly training information about new technology can help us as well.</td>
<td>Through email updates, it is useful if information is organized properly</td>
</tr>
<tr>
<td>It is accessible if you keep proper references in the proper places.</td>
<td>Yes, it is available through internet, intranet and shared places</td>
</tr>
<tr>
<td>We have a senior people who mentor juniors</td>
<td>Learning occurred through series of process</td>
</tr>
<tr>
<td></td>
<td>- Identify the problem</td>
</tr>
<tr>
<td></td>
<td>- Share the problem</td>
</tr>
<tr>
<td></td>
<td>- Choose new ideas</td>
</tr>
<tr>
<td></td>
<td>- Address the issue and prepare solution</td>
</tr>
<tr>
<td>Wiki helps in uploading relevant knowledge as well as document.</td>
<td>Wiki can be used so people can learn themselves. All the information can be consolidated on the wiki and juniors can take help from there, if they run into any issues, they can get in touch with seniors</td>
</tr>
<tr>
<td>We sit together and have brainstorming sessions about it. The most promising solutions are then worked upon by the team.</td>
<td>- Arrange the meetings</td>
</tr>
<tr>
<td></td>
<td>- Present the agenda</td>
</tr>
<tr>
<td></td>
<td>- Through different ideas</td>
</tr>
</tbody>
</table>
We arrange meeting and bring all the people on the same page. Through wiki, we are taken the initial step done with the feedback form.

**Counter the problem**

<table>
<thead>
<tr>
<th>Data Base Architect / developer</th>
<th>Sr. Software Engineer/ Developer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most of knowledge we shared through internet / wiki portals while we have in the organization.</td>
<td>We often make a page with the information we want to share with the help of Wiki and share the created link with concerned fellows. Later fellows comment and give their feedback for more accurate and detail knowledge.</td>
</tr>
<tr>
<td>Yes, it is possible by making different pages and tags.</td>
<td>Yes, wiki has different kind of options that support knowledge sharing including videos, audio, text and pictures.</td>
</tr>
<tr>
<td>We capture the knowledge through involvement of collective intelligence</td>
<td>We take help from social media tool while we perform knowledge activities specially during capturing the knowledge.</td>
</tr>
<tr>
<td>Yes, we upload all our training exercises in the wiki hence knowledge capturing will be occurred.</td>
<td>Yes, we usually capture the knowledge through adding new pages in the wiki so it helps us in consolidating all the information.</td>
</tr>
<tr>
<td>Yes it supports, but in restricted manner.</td>
<td>Yes, People create new pages and move data. around so it is always structured correctly.</td>
</tr>
<tr>
<td>A lot of management required for improving knowledge codification in organization.</td>
<td>Well the problems occur when the terminologies refer to two or more areas of study. Wiki often provide one end. Dividing information as per the terms will definitely help the searchers in better way.</td>
</tr>
<tr>
<td>Wiki allow users from the world to share their [updates /stats] the topic .</td>
<td>Since everything is at the central place, the data has to be [updated]. If is not, other people take responsibility and update it.</td>
</tr>
<tr>
<td>Because organization look around for updating knowledge all the time.</td>
<td>It is not the wiki features and options; it is the user’s volunteers, people running the wiki that [makes it accurate].</td>
</tr>
<tr>
<td>Using wiki, we share our knowledge bases, then other people can [utilize it] .</td>
<td>We put the information and organize by creating different pages, and index pages are created for easy navigation. Wiki also support the searching of content .</td>
</tr>
<tr>
<td>Knowledge driven from existing knowledge base .</td>
<td>I think wiki content is trust worthy if data is unique and knowledgeable, so knowledge [recycling] helps in further utilization of knowledge for specific purpose in software development activities.</td>
</tr>
<tr>
<td>Knowledge without reuse is useless, we may update the existing knowledge, and may get new conclusions from existing knowledge.</td>
<td>Yes it is. Most of the time. That was the basic reason of Setting up the wiki.</td>
</tr>
<tr>
<td><strong>There is no assurance</strong> that wiki helps in promotion of new knowledge because wiki consist of less sufficient to accuracy, truthfulness and professionalism.</td>
<td>Wiki promotes generation of new knowledge but in <strong>restricted manner</strong>.</td>
</tr>
<tr>
<td>Problem occurred when terminologies is referred in two or more areas of concern study and wiki provided only one end area of study, so <strong>dividing information as per the terms</strong> will be helpful to searching.</td>
<td>No, wiki does not support to <strong>identify the right tags and keywords</strong>.</td>
</tr>
<tr>
<td>wiki can organized in such a way that it helps access to the information is very easy</td>
<td>You can read what other people say and it’s not only <strong>bookish information</strong></td>
</tr>
<tr>
<td>Definitely accessible if you keep information on the right places by the help of <strong>proper references</strong>.</td>
<td>It is easily accessible within a <strong>connected group of audience</strong>, but not publicly.</td>
</tr>
<tr>
<td>Occurs through <strong>conducting training sessions and seminars</strong>.</td>
<td><strong>Internet wiki portal</strong> is most effective tool for learning senior and junior employees.</td>
</tr>
<tr>
<td><strong>There is now million of stuff on wiki</strong>, just search for any think you would find the Wikipedia links on top 3 results out of millions results, that is definitely helpful</td>
<td>Yes, we may <strong>upload relevant knowledge</strong> and document through wiki</td>
</tr>
<tr>
<td>By <strong>researching</strong> on it and reading about the similar problems which people have had around the globe.</td>
<td>We normally discuss the complex solution with the <strong>team</strong>, then store and implement on wiki.</td>
</tr>
<tr>
<td>It can be helpful but in a very little way because complex problems are always unique and they are different from what has already been solved</td>
<td>Wiki cannot be enough <strong>intelligent support tool</strong> to derive complex solution, but we can store relevant solutions as soon as we drive them once</td>
</tr>
</tbody>
</table>

<p>| <strong>Software Engineer /Developer</strong> | <strong>Sr. QA Engineer</strong> |
| <strong>We often share the knowledge through new page creation.</strong> | <strong>Wiki portal</strong> is the best option to share the knowledge that is embedded in the organization |
| Yes, wiki is very effective tool specially in sharing organizational knowledge and we use mostly <strong>specialized knowledge folders</strong> for identifying the knowledge that is applicable for us. | <strong>We as a Expert user make a knowledge folders</strong> for concerned user who need for knowledge that is relevant to project, later on it is utilized and identified (demanded knowledge) through our specialized knowledge folders and maps. |
| Without <strong>social interaction</strong> knowledge capturing is not possible. | We take help from <strong>wiki tool</strong> when we are try to capture the knowledge in the organization. |
| <strong>Yes, we use wiki for loading all training materials</strong> as well as <strong>training programs</strong> which can be helpful for other employees who can access this information easily. | <strong>Yes, Creating new pages</strong> is the best option in the wiki because it helps people to capture the knowledge which is completely resided in their minds. |
| <strong>We may upload /store knowledge</strong> on choice of organization either structured or not. | I don’t think it could be supportable in well structured form. |
| It is hard to <strong>identify the right tags and</strong> | Problem occurs when there are many <strong>tags</strong>. |</p>
<table>
<thead>
<tr>
<th><strong>keywords.</strong></th>
<th><strong>words or phrases</strong> used in different studies. Wiki helps directly to search for those terms and in much less time and effort provides the relevant most information available.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wiki tool such as Wikipedia are very helpful for updating and making data accuracy. They have volunteers who keep the knowledge up-to-date or any user can go in and update the wiki. As soon as there is an update a <strong>volunteer would verify the change</strong> till then that updated piece would be <strong>highlighted as red</strong>.</td>
<td>I don’t think there is such support in wiki tools about to [updating], so it can be implemented or it is <strong>up to the administrator who is responsible to the content</strong>.</td>
</tr>
<tr>
<td>If the knowledge is not [accurate], users will not visit wiki, since I think the <strong>data that wiki shares</strong> are the main reason of its popularity.</td>
<td>Accurate knowledge will be helpful for <strong>further product development</strong> as well as knowledge utilization purpose when they were required during the process time.</td>
</tr>
<tr>
<td>We as a developer collect the knowledge from the wiki and [arrange them] by using <strong>wiki docs</strong>.</td>
<td>Yes it can, however there have been a <strong>lot of information</strong> in the wiki to make it successful.</td>
</tr>
<tr>
<td>Reusability of knowledge is possible by means of <strong>proper intelligent search system.</strong></td>
<td><strong>Reuse knowledge is possible through adding, updating, editing and modifying information.</strong></td>
</tr>
<tr>
<td>Yes it is, most of the time that was the basic reason of setting up the wiki and what I’m thinking <strong>sharing of knowledge</strong> proceeds to reusing. Since wiki share its knowledge, it can be [reuse]”.</td>
<td>I don't think wiki provide good options regarding stored knowledge applicable for reuse purpose.</td>
</tr>
<tr>
<td>By using wiki it is <strong>not guarantee</strong> that we can create knowledge content which is applicable for other member to utilize it on efficient and effective manner as well as integrate for knowledge generation purpose.</td>
<td>Through linking knowledge from one place to another place with the help of hyperlinks, images and text.</td>
</tr>
<tr>
<td>Wiki requires <strong>lots of improvements</strong> and management.</td>
<td>Wiki does not support to <strong>identify the right tags and keywords</strong> at the right time and right place.</td>
</tr>
<tr>
<td>If it is about learning a new tool or technology, the tool and techniques are provided in the <strong>wiki post</strong></td>
<td>it is not the wiki that helps but the <strong>content in the wiki</strong> is helpful.</td>
</tr>
<tr>
<td><strong>Yes it is accessible through under the control of group audience.</strong></td>
<td><strong>If information is organized properly.</strong></td>
</tr>
<tr>
<td><strong>Usually occur through mentoring junior employees.</strong></td>
<td>Happening through sharing of knowledge over email.</td>
</tr>
<tr>
<td><strong>Yes wiki can be helpful in learning process if people can keep it updated with their findings and research.</strong></td>
<td>It cannot completely take over the regular learning process but it can certainly help in making things quick.</td>
</tr>
</tbody>
</table>
Discuss complex problem with the **persons and in conference call** and then implement for achieving learning goals.  

<table>
<thead>
<tr>
<th>Brainstorming session and group action is mostly helpful in solve the complex problem.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wiki can be helpful in such way that it would avoid Drop box (knowledge sharing tool) but still it doesn’t support collaboration (multi user editing). Complex problem are solved through series of steps and wiki can be one part of it. Only wiki can’t be used to solve complex problems</td>
</tr>
<tr>
<td>We discuss complex problem in wiki through feedback forms.</td>
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</tbody>
</table>

### QA Engineer

We mostly prefer to share the tacit knowledge in organization by the using of wiki tool because, it is advantageous for other who located dispersedly.

Wiki has options available to connect knowledge through topics and tags, later on concerned fellows search the relevant project knowledge that would be useful for project enhancement and development.

Through manual process we capture the all knowledge that is available in structured form.

No, everything has to be done through manual process. I don’t think wiki could be helpful regarding these situations.

Yes, wiki has option to support structured knowledge but in restricted way.

Wiki is not the best tool for codifying knowledge; lot of improvement is required as well as formatting standards.

Wiki allow users from the world to share their [updates/stats] about the topic.

Due to centralize nature; user can edit and revert back easily.

**It takes time to organize and manage knowledge** that is available in the tool.

I don’t think so knowledge reuse in wiki is possible or not.

Of course once stored knowledge can be accessed again and again.

Through **Specialized knowledge folders** specific concerned to departmental stuffs.

It is very difficult in wiki to **identify the right knowledge** for the right person. It needs
improvement as well as management.

Although, I haven’t done it yet, but would suggest **categorizing stuff based on subjects**

The wiki can be quite organized such that access to the information is very easy.

Learning takes place when **presentation activities** being perform among the employees.

It is going to be a **slow process**. Wiki will serve as another resource for research. It may help in understanding but is not a replacement for person to person learning.

Through performing some **immediate action** as well as senior experts who know how to solve the complex problem.

Through identifying knowledge that is stored in wiki and solved by concerned person earlier.
## Appendix C – Coding

<table>
<thead>
<tr>
<th>Interview Questions</th>
<th>CTO</th>
<th>Project Manager</th>
<th>Software Architecture</th>
<th>Database Architect/Developer</th>
<th>Sr. Software Engineer</th>
<th>Software Engineer</th>
<th>Sr. QA Engineer</th>
<th>QA Engineer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How do you share the organizational tacit knowledge that is in your mind during DSDP?</td>
<td>Training session</td>
<td>Internet/wiki portals</td>
<td>Over email</td>
<td>Internet/wiki portals</td>
<td>Make a page/created links</td>
<td>New page creation</td>
<td>Wiki portal</td>
<td>Wiki tool</td>
</tr>
<tr>
<td>2. Is wiki effective to support organizational tacit knowledge during socialization process?</td>
<td>With the help of gathering</td>
<td>Topics/subject/departmental stuffs/favorite links/material links/surfed links</td>
<td>Wiki setup/specialized knowledge folders/HR/admin &amp; operations/technical</td>
<td>Pages &amp; tags</td>
<td>Videos/audios/text/pictures</td>
<td>Specialized knowledge folders</td>
<td>Knowledge folders or maps</td>
<td>Topic &amp; tags</td>
</tr>
<tr>
<td>4. Is wiki effective in Capturing the knowledge during the work</td>
<td>Yes</td>
<td>No, manual work</td>
<td>Yes, adding new pages</td>
<td>Yes, upload training exercise/yes, adding new pages</td>
<td>Yes, creating new pages</td>
<td>No, manual process</td>
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</table>

93
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<thead>
<tr>
<th>5. Does wiki support structured or unstructured knowledge content during the time of knowledge capturing?</th>
<th>Yes, roles of knowledge sharing (producer, intermediary, consumer)</th>
<th>Yes, through Submit knowledge</th>
<th>Load / extract page</th>
<th>Yes, restricted manner</th>
<th>Yes, create new page</th>
<th>Upload/store knowledge</th>
<th>NO</th>
<th>Yes, restricted way</th>
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<tr>
<td>6. What are the problems you often face while codifying the organizational knowledge during DSDP?</td>
<td>Codify knowledge easily</td>
<td>Rely on correct keywords/right content/coding</td>
<td>Informal way/difficult to organize knowledge</td>
<td>Lot of management required</td>
<td>Terminologies refer to two or more areas of study</td>
<td>Identify right tags and keywords</td>
<td>Different form of tags/words/phrases</td>
<td>Improvement required in formatting standards</td>
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<tr>
<td>7. How does wiki support for keeping organizational knowledge up to date and accurate? If yes then how</td>
<td>Owner responsible for knowledge</td>
<td>Through Centralize nature of wiki always updated &amp; accurate</td>
<td>Wiki investigation of content</td>
<td>Through update/statistics about the topics</td>
<td>Centralize nature of wiki always updated</td>
<td>To verify change through highlighted option</td>
<td>Depends on administrator or content owner</td>
<td>Through update/statistics about the topics</td>
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<tr>
<td>8. Why is it necessary to have</td>
<td>To revert the older</td>
<td>Rely on existing knowledge</td>
<td>Revert back to older</td>
<td>Organizational looking around</td>
<td>Volunteering running</td>
<td>Data that wiki shares</td>
<td>Further product develop</td>
<td>User can edit</td>
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<td>considered the wiki for data accuracy?</td>
<td>version of knowledge</td>
<td>ge</td>
<td>version</td>
<td>updating knowledge</td>
<td>the wiki</td>
<td>ment</td>
<td>or revert back easily</td>
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<tr>
<td>Through different topics/subject/departmental stuff in separate folders</td>
<td>Wiki pages for all organization area</td>
<td>Mostly through comments</td>
<td>knowledge base</td>
<td>Creating index pages</td>
<td>By using wiki docs</td>
<td>Lot of information in the wiki</td>
<td>It takes time to manage and organize knowledge</td>
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<tr>
<td>9. What do you think that wiki can be helpful for managing and organization knowledge in an efficient manner?</td>
<td>Utilize through valid information</td>
<td>Search the right content</td>
<td>Utilize the existing knowledge base</td>
<td>Existing knowledge bases</td>
<td>If data is unique and knowledgable</td>
<td>Proper intelligent search system</td>
<td>Adding, updating, editing &amp; modifying information</td>
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<td>10. How does wiki support reuse of knowledge in DSDP? If yes then how</td>
<td>We took decision on the bases of knowledge</td>
<td>Extract new ideas from existing knowledge</td>
<td>Get new conclusion from existing knowledge</td>
<td>Setting up the wiki</td>
<td>Yes through of knowledge</td>
<td>Not applicable</td>
<td>No support</td>
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<td>11. What do you think stored knowledge is applicable for reuse again?</td>
<td>Wiki itself supportive tool</td>
<td>Hyperlinks/images/text</td>
<td>Knowledge section/stub</td>
<td>It does not promote</td>
<td>In restricted manner</td>
<td>No suppose</td>
<td>Through linking knowledge</td>
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<td>12. How does wiki promotes generation of new knowledge through internalization</td>
<td>Mixed/edited/synthesize project specific knowledge content</td>
<td>Hyperlinks/images/text</td>
<td>Knowledge section/stub</td>
<td>It does not promote</td>
<td>In restricted manner</td>
<td>No suppose</td>
<td>Through linking knowledge</td>
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<tr>
<td>13. Is wiki helpful for searching relevant knowledge that is belong to specific individual?</td>
<td>NO</td>
<td>No support of right tags &amp; keywords</td>
<td>No, far away from basic level of formatting</td>
<td>Problem in searching terminologies</td>
<td>No support of right tags &amp; keywords</td>
<td>No, Lot of management required</td>
<td>No support of right tags &amp; keywords</td>
<td>No support of right tags &amp; keywords</td>
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<tr>
<td>14. How do you create and apply new knowledge through wiki in DSDP?</td>
<td>Use multiple sources</td>
<td>Through put everything in the wiki/ training information</td>
<td>Through email updates</td>
<td>Through wiki tool</td>
<td>Rely on people perception &amp; not on bookish information</td>
<td>Through wiki post</td>
<td>Through wiki content</td>
<td>Categorization stuff based on subjects</td>
</tr>
<tr>
<td>15. What do you think that creating new knowledge with the help of wiki is accessible or not? if accessible then how</td>
<td>Internet/intranet/shared places</td>
<td>If kept proper references</td>
<td>Internet/intranet/shared places</td>
<td>If kept proper references</td>
<td>Through connecte d group of audience</td>
<td>Through under the control of group audience</td>
<td>If information is organized properly</td>
<td>Yes , it accessible b/c wiki is itself organized</td>
</tr>
<tr>
<td>16. How does virtual organizational learning take place in DSDP?</td>
<td>Presentation/training session/seminars/emails/syllabus/wiki portals</td>
<td>Through mentor junior</td>
<td>Series of process ing steps</td>
<td>Training session &amp; seminars</td>
<td>Internet wiki portals</td>
<td>Mentorin g junior employee</td>
<td>Over email</td>
<td>Throu gh presentation activities</td>
</tr>
<tr>
<td>17. Do you think that</td>
<td>Through identify</td>
<td>Through Wikiped</td>
<td>Upload relevant</td>
<td>Finding &amp; research</td>
<td>Complete ly take</td>
<td>Upload relevant</td>
<td>Wiki itself is</td>
<td>Does Not</td>
</tr>
<tr>
<td>Question</td>
<td>Method</td>
<td>Wiki can be helpful in virtual organization learning within the virtual team? If yes then how.</td>
<td>What about your perception regarding wiki in organization learning in DSDP?</td>
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<tr>
<td>19. What about your perception regarding wiki can be helpful for solving complex problem in DSDP?</td>
<td>Start posting information</td>
<td>Through brainstorming session</td>
<td>Through series of insurgenent steps Throug research &amp; exploring Persons conferenc e calls Brainstorming session /group action Performi ng immedia te action Discuss with the team members</td>
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<tr>
<td></td>
<td>Bring people on same page/feedback form</td>
<td>Throug research &amp; exploring Persons conferenc e calls Brainstorming session /group action Performi ng immedia te action Discuss with the team members</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Knowledg e sharing &amp; accessi bility</td>
<td>It can. but complex problem are always unique No, due to insufficie nt intelligen t support No, does not support multi collabora tion/ Yes, through feedbac k form Yes through identifying knowledge that has stored</td>
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</tbody>
</table>
Appendix D – Company Documents

Socializing: Employees interaction through tool
Wiki portal
Wiki document library
Specialized knowledge folders: including Tags and category

Thank You