Knowledge Management in Pair Programming- A Survey

Research Report

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I. Group Members' Participation

The group members participated in idea creation and in report writing with the following amount of involvement.

Group Member	Idea Creation	Report Writing
Gamini devi Charan	50 %	50%
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***Abstract*—Knowledge is considered as the most valuable asset by organizations of any field. Knowledge management ensures that knowledge is provided and utilized throughout the organization. Knowledge management involves knowledge creation, Knowledge gathering, Knowledge storage, Knowledge transfer - major activities of Knowledge management. Pair programming is the method in which a pair of programmers work together on same computer. Pair programming act as an aid to software organizations regarding knowledge management. The authors conducted a survey to investigate the software practitioner's perspective in the context of pair programming. Our research aim is to provide the software community with an overview of practitioners on knowledge management in pair programming and challenges of pair programming with different knowledge. The results reveal that the organizations can rely on pair programming as an aid for knowledge transfer.**

Results-- Respondents with experience in pair programming were considered for our survey. Most of the respondents have agreed on using pair programming as a knowledge transfer method and have mentioned the problems face while pair programming with different knowledges. It revealed that communication (verbal) is considered a major challenge to be addressed in pair programming.

Conclusion-- Even though there are many ways of transferring knowledge in an organization, from the view of practitioners is that pair programming is a good reliable Knowledge transfer method.

Keywords: Knowledge management, pair programming, agile software development

II. Introduction

Knowledge accessible by any software organization is the main asset that holds advantage over the competitors. Success of any software project strongly depends on the employee knowledge and their working experience [1]. Knowledge management is identification, creating, development, storing, measurement and transfer of knowledge [2]. But Knowledge creation, transfer, storage are considered as the most important [2]. Pair programming is termed as two programmers supporting each other with code, design to work on a project [3].

Based on the pilot SLR conducted, the authors identified that research was performed regarding the productivity of pair programming. But, there is a lack of research on whether the software organizations can rely on pair programming for knowledge management or not.

The aim of our research is to study problems faced by pair programmers with different knowledge and view of them on pair programming as a knowledge transfer method. The authors also tried to investigate challenges faced by practitioners while implementing pair programming. The authors intended to perform survey using online questionnaire as an aid for the research.

For our research we found online survey method as best suited way to answer our research questions as the research questions we have formulated can be easily answered by professionals with pair programming experience. Questionnaire is the data collection method and grounded theory is used for analysis of surveyed data.

The authors intend to present the software organizations and the community of software with a review of the knowledge management using pair programming approach. A review of the challenges allows the organizations to improve the knowledge management process using pair programming and the practitioners view can help know if they are considering it reliable.

This research report is structured as follows: Section III presents the background and rationale behind performing this research. Section IV presents research definition and research plan. Section V presents the research operation. Furthermore, the data analysis and interpretation are described in Section VI. Section VII presents the results, threats to validity and limitations to our research. Section VIII presents summary of our research and further research that can be carried out to enhance the scope and quality of presented research.

III. Background and Motivation

Pair programming is generally used for productivity and quality of software project. The efficiency of pair

programming is presented in the literature by conducting various experiments over software practitioners in organizations. Before the use of agile software methods, knowledge transfer methods like socialization and externalization were used to transfer tacit knowledge.

Our motivation is to investigate on how much practitioners view pair programming as a reliable method for knowledge transfer. Pair programming is used in software organizations but not mainly for the purpose of knowledge transfer. We intend to investigate that pair programming is a reliable knowledge transfer technique or the practitioners are having problems considering it reliable? And we also have to overcome the challenges faced while implementing pair programming. The contribution done by other authors in this field is stated below.

Franz zieris [4] have done research on the quality analysis of knowledge transfer in pair programming. Based on their case studies, they have revealed the behavioral patterns of experts in pair programming. They also presented the quality of knowledge transfer in pair programming.

Kavitha and Irfan [5] have proposed a framework for knowledge management in agile software development teams. The framework describes a collection of integrated tools that support capturing, storing and sharing of knowledge.

Meira and orit in [6] have done a research through interviews on how to overcome the cultural boundaries of implementing knowledge transfer in pair programming.

In the end we have noticed that pair programming shows better project results. But no research is done to support this statement. So this serves as a rationale behind conducting this research.

The knowledge on pair programming in context of knowledge management and challenges faced can act as an aid to improve the quality of pair programming for knowledge management. This makes use of pair programming as a dominant knowledge transfer method and allows for improvisation in its implementation.

There are no much researches on the problems faced during pair programming. Our research mainly focuses on problems faced while pairing two programmers with different knowledge and it also focuses on practitioners view on pair programming. As it the most important for any method to be successful. Our research will help to focus on improvement of pair programming method.

IV. RESEARCH DEFINITION AND PLAN

A. Research objective:

The main objective of our research is to study the implementation of knowledge management in pair programing. The research is mainly associated with the knowledge transfer in pair programming by conducting a survey. The authors formulated two objectives to address the research problem.

- To investigate if the software practitioners consider pair programming reliable for knowledge transfer.
- To investigate the challenges faced while implementing pair programming.

B. Research questions:

By conducting literature review, we began our research on Knowledge management focusing its implementation methods in a software environment. We then narrowed down our topic on to pair programming in agile software development. It is the method used by software organization for better results in end products. Next, we focused our research on how reliable is pair programming for an organization to gather new knowledge and transfer that within employees. This led to the formation of the following research questions:

RQ1: What is the view of practitioners of pair programming on the reliability of pair programming as knowledge transfer method?

> **Motivation:** we got motivation for this question by observing the lack of any type of research on reliability of pair programming for knowledge transfer.

RQ2: what are the challenges faced while pairing two programmers with different knowledge on the software project?

> **Motivation:** we got motivation for this research question as it is important to know the challenges so to overcome them and make pair programming a better method. The research questions are answered in the results section of this report. The answers are gathered using the survey method.

We are going to answer the research questions with help of the online survey. This is done with the help of online forms.

C. Research method:

We have considered different research methods which include the action research, ethnographies, experiments, survey and case studies. Reference [7] act as an aid to support the method selected for this research. It helped us to examine the goals of each research method and to know the different types of questions that are to be answered.

The research questions we have stated are *Analytical questions*, we have chosen *empirical survey* as our research method. We have selected "positivity" which states that information must be from the logical inference of the observational facts [7]. Motivation for choosing positivism is that our research questions are on how the pair programming method is reliable for knowledge transfer, so we found this helpful for our research.

D. Units of analysis:

We have to choose a study sample before we start any survey. Sampling is divided into two probabilistic and non-probabilistic sampling [8]. We have used non-probabilistic sampling for selecting our audience to answer survey. We consider software organizations as our unit of analysis (subject). As our research questions are specific to pair programming in software organizations, we have chosen our target population to be professionals working in software organizations in pair programming sector. We contacted many

software organizations to know if they using pair programming method. While selecting our target audience we have concentrated on following:

• Their designation in the organization.

Reason: This will help us to survey professionals only from knowledge management as they are the ones facing the problems with knowledge creation.

• Their experience.

Reason: This will help us to generalize the results obtained from the online questionnaire.

E. Data collection methods:

After deciding upon the target population of the research, we started focusing on collecting emails and links of companies and almost every software company implements pair programming. We have created an online questionnaire, where our target audience with experience in pair programming can answer the survey. This questionnaire is a google form created using form options in google drive. We then mailed our questionnaire to software professionals in software companies and asked them to answer the survey. We have taken care designing the survey based on literature defining the guidelines for conducting online surveys [9]. Our mail included with following information:

• Who we are and the purpose of our survey and we have also stated how the information provided by them is going to be used.

• Link to questionnaire. Responses were formulated into a excel sheet with different respondents and their responses. If we had any questions regarding the responses the specific respondent was emailed or telephoned for further clarifications. This helped in understanding the responses.

F. Data analysis method:

We have used Grounded theory approach, it is the main approach used to build theory from empirical data [10]. Hence, we chose this approach as it best suits our purpose. We chose this approach as the data collection and data analysis can be linked with each other. The theory is derived from the data obtained and the validity of the created theory strengthens with each collected input [11].

V. RESEARCH OPERATION

A. Research operation:

After performing Literature Review (LR) with a team of two members on Knowledge management and after acceptance of our research proposal on knowledge management in pair programming, we started doing survey for our research report. The following diagram is the total process we have followed from literature review to Report:

After selecting our research topic, literature review was done in 16 days. SLR helped us to find the limited research on knowledge management in pair programming.

Research questions were formulated on the research gap. We have selected online survey as our research method to get results. This total research was done in 45 days of time.

As our research questions were analytical questions on pair programming, for results we have selected online questionnaire as our survey instrument. Target audience were selected in the fact that the professionals from pair programming can answer the questionnaire and can be done in time by surveying professionals. So, organizations dealing with pair programming were chosen to conduct the survey.

Questionnaire for survey was created in Google forms. This survey focuses on knowledge transfer between pair programmers in software organizations. Only the necessary and relevant questions were included in the survey. The survey totally has 4 questions and the form is presented in the appendix A.

The duration for conducting the survey was 10 days so that the respondents could get enough time to provide qualitative data. . Participants in the survey were frequently reminded to take part in the survey. After collecting all the data, statistical analysis was done and grounded theory was performed to obtain results.

In the 10 days of survey time we have got 25 responses in total. An exclusion criteria was used so that only reliable responses are obtained. The exclusion criteria is as follows:

- If the respondents are not from the field of Pair programming then the responses were excluded.
- If the respondents lack experience or incomplete survey responses were excluded.

B. Quality assurance:

We have chosen our target audience to be professionals in pair programming from software organizations. We have consulted many organizations to know if they are working with pair programming. Mainly multi-national organizations were selected as the information they have and the working employees are more in number. There is chance for participants to misunderstand the questions presented in the questionnaire, so we have used simple language for them to read. We made sure that the results were relevant to our research. Respondent's designation was not revealed so that there is no influence in considering results. Approaching only professionals working in software organizations helped us to ensure the quality of the data collected.

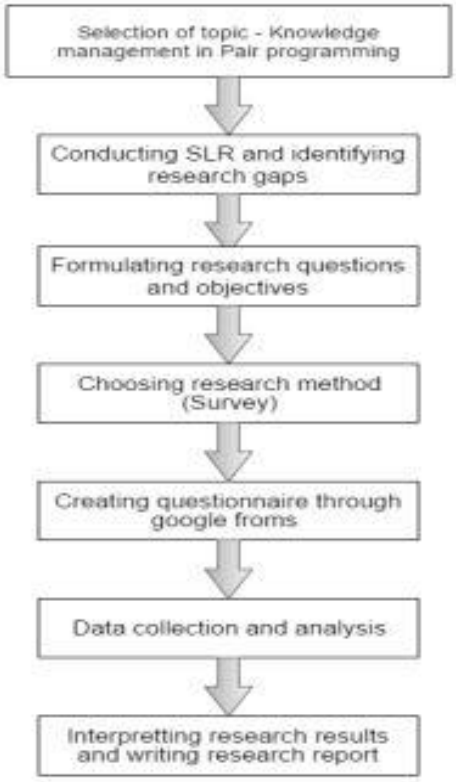

Figure 1: Research operation

VI. Data Analysis and Interpretation

A. *Data Analysis:*

Our research questions RQ-1 and RQ-2 are specific to Pair programming. So to answer our research question RQ 2 we have divided programmers with pair programming experience into two categories 1) Driver 2) Navigator. For the analysis of data from the survey we have considered experience and their part in pair programming. The respondents who answered our survey are illustrated in figure 2 and 3 below.

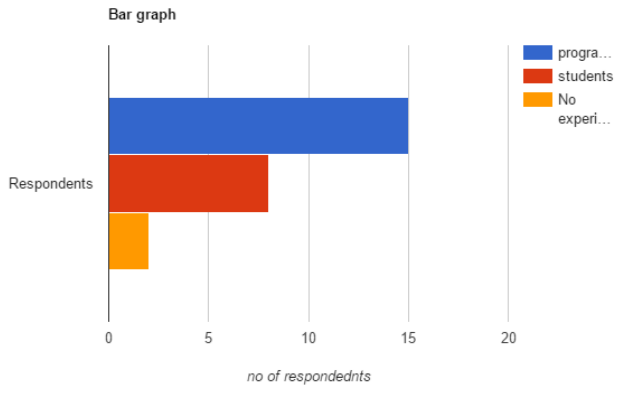

Figure 2: frequency of respondents of survey

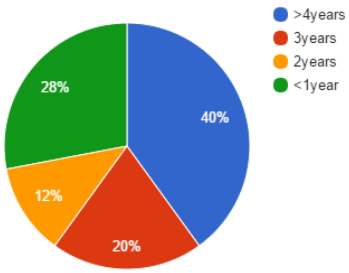

Figure 3: Experience in pair programming

These figures show the experience of respondents and the number of respondents and their designations. Data analysis of qualitative research is done by going through collected data, arranging important data and searching for required information supporting our research. Main problem in qualitative research is to build theory from the collected data. This is solved by Grounded theory approach [12]. It helps to build new theory from the evidence, so the resulting theory is consistent from empirical data [12].

B. *Interpretation:*

Based on the responses from survey we have analysed, answers to our research questions as:

Answers to RQ-1:
(Supporting view for pair programming as a reliable method)

- Knowledge transfer is the difficult part for organizations but it can be easily done through pair programming.
- Instead of relying on data gathering techniques, pair programming can serve any organization better.
- Conversion of tacit knowledge to tacit i.e. transfer of tacit knowledge is a difficult process. So, pair programming can be used to transfer knowledge to other employees. It is better than standard knowledge transfer techniques like socialization.

(Responses not supporting Pair programming)

- Some of the respondents considered pair programming as not much reliable method for knowledge transfer.
- Lack of communication between the pair programmers can affect the main objective of knowledge transfer.
- Some of the employees refuse to share their knowledge as they consider knowledge as an advantage over other employees.

Answers to RQ-2:

- Transfer of tacit knowledge to tacit knowledge i.e., knowledge transfer from expert to beginner is sometimes difficult to achieve as the communication (verbalization) is a problem.
- If pairing of an expert with a beginner is done then the expert might find it difficult to answer the basic questions from beginner.
- When pairing programmers with different knowledge on a project. They will try to learn what the other programmer's knowledge. So they must follow an order in gaining knowledge.
- Pair programmers must not lose their on the argument until it is closed. If not closed there is a chance of other arising and loosing track of previous argument.
- The expert must take care while teaching new knowledge like making multiple topics of complex subjects.

VII. Discussion

A. Contirbutions:

Our research on knowledge management in pair programming provides a view of knowledge distribution in pair programing. Previous works were not concentrated on use of Pair programming as knowledge management method. Through our research we were able to gather views of different people on pair programming and were able to provide clear statements answering our research questions. We have provided how programmers think about reliable use of pair programming for knowledge transfer and their reasons for their argument. This survey lead us to a point that pair programming can be a good and reliable knowledge transfer method. We also got the challenges faced by programmers in pair programming with different knowledge. We have also surveyed to know if pair programming reduces the risk of employee turnover.

B. Threats to validity:

The validity threats that are likely to effect a research are studied from [13].

- *Researcher bias:* We have selected grounded theory approach for analyzing results. There was no bias among researchers.
- *Respondent's bias:* we made sure that respondents details
  were kept anonymous so that there is no influence on researchers on analyzing responses.
- *Internal validity threat:* There is a chance of drawing incorrect data from unfamiliar target audience.so, use of exclusion criteria helped us to ease this problem.
- *External validity threat:* There is a chance of external validity threat when research done on a very small population. But it has been proven with experiments that pair programming produces best results. So taking large population into survey will not change the conclusion.
- *Construct validity threats:* There is a chance of respondents misunderstanding the questions. So, easy language was used to write questionnaire.
- *Conclusion validity:* There is a chance of wrong conclusions drawn from the data analysis. So, more time was given for data analysis.

C. Limitations:

Due to limited time we couldn't get more respondents to answer our survey and because we are new to surveys and data analysis we may have missed some information. We may not had our survey answered by the best of professionals. Due to limited knowledge on surveys and data extraction we might have missed some important points.

VIII. Summary and Conclusions

Pair programming is an important method for better results, conservation of time and quality of software project. Pair programming is not widely used for the sole purpose of knowledge transfer. The purpose of this paper was to provide information whether practitioners think they could rely on pair programming as an approach for knowledge transfer or not and problems faced with pair programming. On conducting the survey, it is identified that software practitioners and organizations can rely on pair programming for knowledge management activities. It is also revealed from the survey results that communication (verbalization) is the main challenge while implementing pair programming with different knowledge programmers. The problems of expressing each other is making pair programming difficult to implement.

Hence, our research suggest the use of pair programming as a knowledge management approach in software organizations by overcoming the revealed challenges. Further research can be done on evaluating the performance of pair programming and socialization in knowledge transfer.

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