Autonomous teams and Teamwork Effectiveness in Global Software Development

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
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Abstract—**This document is a research paper that studies about the effect cultural differences on autonomous teams and their teamwork effectiveness. Through this research we intend to analyze this effect. Survey has been used as method to answer the research questions. The results identify the factors that have an impact on autonomous teams and their effectiveness.**

II. INTRODUCTION

Background: Global Software Development (GSD) has been the most popular activity used by the software industries for developing their software projects. Using this, projects can be outsourced to countries having low economy and high skilled labor [1]. Presently, majority of the top multi-national software companies are giving GSD as their highest priority because of its cost saving advantage. Research have also been proposed for merging agile methodologies with GSD [2]. This leads to the solutions for various other challenges such as communication between the members in different geographical borders. Agile methodology also includes few technical teams which are independent of their work called the autonomous teams. These teams do not have any higher officials to dominate them. But these teams can be affected by the cultural differences that exists in GSD.

Problem Domain: Even though a lot of literature is present in the field of GSD, according to our understanding we think that there has been a research gap regarding the effect of cultural differences on team autonomy. Socio-cultural differences make the team members to struggle in following technical discussions in a way leading to misunderstandings [3]. We have also focused on how these autonomous teams performs in the real world of GSD.

Objectives: Through this research, we mainly aim to identify the different cultural differences and analyze their effects on implementing team autonomy in GSD projects. This particular research also targets on the issue of effectiveness of autonomous teams in team work of distributed projects. Two research questions were formulated based on the problem domain addressing the different problems.

Method: A survey method has been chosen to address the issues regarding the effects of cultural differences on autonomous teams. Survey method is chosen because this helps in providing an empirical evidence from a specific group of population which in general provides support for the solutions prescribed. The data obtained through survey was analyzed using Grounded theory.

Contributions: This research studies about the effect of cultural differences on autonomous teams. And teamwork effectiveness of autonomous teams in agile GSD environment.

Structure: Section III describes about the related work and the motivation for the current research. Section IV describes the research definition and plan for this research. Section V describes about the research operation. Section VI describes about the data analysis & interpretation. Section VII describes about the contributions and threat to validity. Section VIII dives the summary and conclusions of the research.

III. BACKGROUND AND MOTIVATION

GSD has become popular and it is widely used nowadays in organizations all around the world. Its popularity comes from the opportunity to offshore the work to low cost economies where development costs are less and availability of highly skilled labor at low costs [1]. Some of its popularity comes from continuous development of the product by using follow the sun approach [4]. Despite these benefits there are many drawbacks to GSD that can overshadow these benefits.

Drawbacks like geographical, temporal, cultural differences can minimize the benefits that are expected from GSD [5]. The success of the outsourcing projects depends on the differences in the organizations that are involved [6]. Greater the difference lesser the success of the project. These drawbacks can affect the major aspects of software process communication, control and coordination [5].

Research has been done to improve the benefits of GSD by applying agile methodologies for development. Agile methodologies involve continuous short iterations that enable for constant feedback to continuously improve the product. The teams used in agile methodologies are called self-organizing teams or autonomous teams. These are empowered teams that have the power to make their own decisions, assign

tasks between them, create their own deadlines and planning [7]. But these teams are difficult to implement in GSD because of the differences. This can create conflicts and increase distrust between the members of the team [5].

Cultural difference is a central issue in GSD. These differences can be language, organizational culture, political difference, individual perceptions and motivation [8]. Hofstede's work states five dimensions of cultural difference [9]. These can cause a hindrance to the autonomous teams.

GSD projects involve ambiguity and uncertainty which can lead to problems {reference}. These problems can be solved quickly and accurately by bringing the decision making to the teams. This allows for improving the teamwork effectiveness [7]. In some countries decision making authority lies with the central management. This can increase the fear of distrust in the employees which affects the effectiveness of autonomous teams.

Importance to the problem: GSD is being adopted by many organizations nowadays to avail its benefits despite the drawbacks. So it is important to find how these cultural difference affect autonomous teams and improve their teamwork effectiveness. By doing this research the benefits of the GSD can be further improved. By analyzing the effects on autonomous teams the impact of these differences can be reduced by creating mitigation strategies. Which can improve the cost effectiveness and quality of the product.

IV.   RESEARCH DEFINITION AND PLAN

Aim:
The aim of this project is to find the implications of cultural difference on autonomous teams in agile GSD environment.

Objectives:
- To analyze the effects of cultural difference on autonomous teams in agile GSD environment.
- To analyze the teamwork effectiveness of autonomous teams in agile GSD environment.

Research Questions:
RQ1) what is the effect of cultural difference on autonomous teams in agile GSD?
RQ2) Determining the teamwork effectiveness of autonomous teams in agile GSD?

Research method:
The method chosen to answer RQ1 is Survey method. There is a lot of literature on the cultural differences in GSD and on how to reduce the impact of these differences. But there is very limited research on how these cultural differences effect the autonomous teams in agile GSD environment. So we chose survey method to identify the cultural differences and their effect on autonomous teams. Because survey method can be used to gain knowledge of the current practice in the field. It can also be used to gain useful information in considerably less amount of time.

For answering RQ2 first a literature study will be conducted to identify the factors that have an impact in teamwork effectiveness. Then these factors are empirically validated against the data gathered in RQ1 to determine the teamwork effectiveness of autonomous teams.

Unit of analysis:
It is important to identify the particular unit of analysis that can be useful for the research. The unit of analysis should be fitting to the research conducted because it is used in answering the research questions. Sampling methods were used as unit of analysis in our research. For our research the main unit of approach will be software engineers that practice agile methodologies in a GSD environment. After formulating the questionnaire, we have used sampling methods to gather data. Since it is time consuming and costly to gather data from all the target population, sampling is done such that a small sample is selected where the information gathered can be generalized to a larger population. First random sampling was conducted where all the members answering the questionnaire have an equal and independent chance of being selected. The survey was posted in LinkedIn site. This method is chosen because it is easy to conduct and it has a higher probability of getting a representative sample. Then snowball sampling is used to gather data and add it to the existing data. Through this data can be gathered from the relevant hidden subjects that can be useful to the research. Finally, convenience sampling was used to gather data form the easily available members. From the survey we have got 11 results, 2 of them were sent through emails. And the others were through the survey posted in LinkedIn site.

Data collection method:
In survey method data can be collected through interviews and questionnaire. Through interviews effective data can be gathered for the research. But it is difficult to interview all the members in the sample and it is not cost effective for some research. So questionnaire is used in our research since large amount of data can be gathered in less amount of time. Questionnaire are the most common field that can be administered quickly and easily [10]. The questionnaire we have formulated were open ended so as not to limit the choice of participants who can answer. This can be useful in gathering additional relevant data for the research. The survey was posted in LinkedIn site. The results were listed out in an excel sheet for data analysis.

Data analysis:
Data gathered from the survey was analyzed using grounded theory. Using grounded theory data can be analyzed from the time data is first collected in the survey to the end of the survey. Grounded theory is used since the data to be collected is qualitative[11]. It generates theory systematically from the data using both inductive and deductive thinking. From the gathered data relevant concepts or elements are tagged with codes. As more data

is collected these codes are gathered to form concepts that are similar. These concepts are then clustered into categories that are similar. Through which the required information can be extracted. This is called open coding. Using this method, the cultural differences that can have an impact on the autonomous teams can be identified and analyzed. The same method is used in analyzing the data gathered in the literature study for RQ2. The factors that affect teamwork effectiveness are identified.
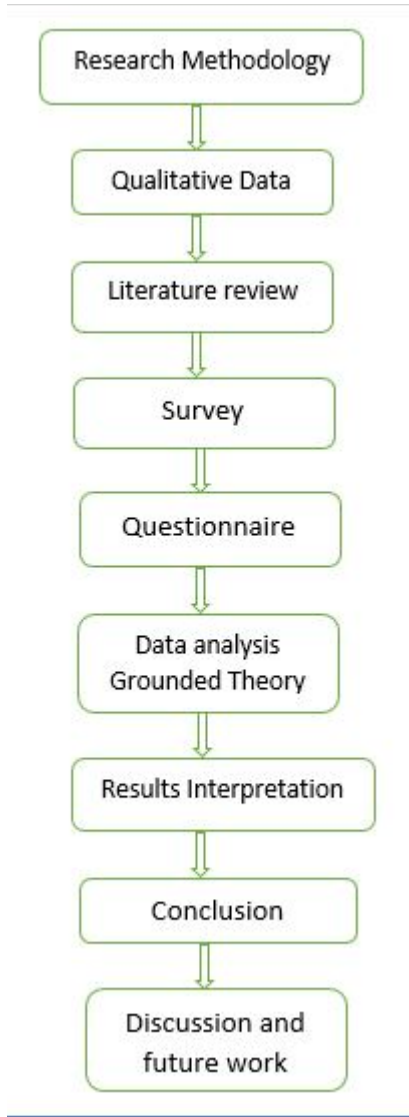

Fig 1- Research Method

V. RESEARCH OPERATION

A. Operation:

This section describes about the process of the research conducted. First a literature study is conducted to identify the cultural differences that can have an impact on autonomous teams. Survey was chosen as the method to answer the RQ1. The data needed was collected through questionnaire. The questionnaire was formulated based on the information gathered in the literature study. The questionnaire was formulated such that the responses collected discusses about the effects of cultural difference on autonomous teams. Questionnaire were posted in LinkedIn site. Sampling the population enabled us to gather information required from the GSD practitioners who agile methodologies. Then the data gathered in the survey was analyzed using grounded theory. 9 responses were collected from the questionnaire posted in LinkedIn and 2 responses were from the questionnaire sent through mail. For answering RQ2 a literature study was conducted to identify the factors that have an impact on the teamwork effectiveness. And those factors were validated against the data gathered in the survey.

B. Quailty Assurance:

The questionnaire was formulated in a way that the respondent's response is useful to the researchers. For this previous papers that used survey method through questionnaire were referred to gain knowledge on how the questionnaire should be formulated. Appropriate sampling methods were used so that the sample population were indeed agile GSD practitioners who can reflect upon the study. To ensure the quality of data gathered.

VI. DATA ANALYSIS AND INTERPRETATION

In this section we discuss about the data analysis based on the survey and the literature. Questionnaire were used for data collection. Totally 11 relevant responses were obtained from the survey.

The 11 respondents of the survey were from 3 different designations of GSD practitioners. They were developers, testers, project managers. The respondents were 54% developers, 28% testers, 18% project managers.

RQ1) what is the effect of cultural difference on autonomous teams in agile GSD?
To answer this question first a literature study was conducted to identify the cultural differences that exist in GSD. These were the differences identified in the literature [9][8]:

- Power distance
- Individualism/Collectivism
- Uncertainty avoidance
- Long/short term orientation
- Motivation
- Language
- Political differences

Then a survey is conducted to analyze the effect of these cultural difference on the autonomous teams. Extracted data is analyzed using grounded theory. The identical elements in the data are tagged with codes. The codes are clustered under similar concepts. These

concepts are studied to give rise to theory. These are tabulated below.

Identical elements	Codes	Concepts	Theory
Organizational structure, decision making authority	Structure	Power distance	Organizational structure has an impact on team autonomy
Individual perceptions, driving force	Goals	Motivation	Employee motivation has an impact on team autonomy
Behavior, team oriented	Employee opinion	Individualism/collectivism	Behavior of the employees has an impact on team autonomy
Encouragement, risk taking	Risks	Uncertainty avoidance	Risk taking of the organization has an impact on team autonomy

Table-1

The impact of the cultural differences on team autonomy are summarized in tabulated below.
'+' implies positive, '-' implies negative, 'O' implies neutral.

Team autonomy	Power distance		motivation	Individualism/collectivism	Uncertainty avoidance	
	high	low			high	low
decision making	-	+	+	-/+	_	+
Assigning tasks	-	+	+	-/+	O	O
Creating deadlines	-	+	O	O/O	_	+
planning	-	+	+	-/+	_	+

Table – 2

RQ2) Determining the team work effectiveness of autonomous teams in agile GSD?
To answer this question a literature study has been conducted to identify the factors that determine the teamwork effectiveness. These are factors [12][13] identified.
- Communication
- Coordination
- Effort
- Cohesion

These factors are evaluated to determine the teamwork effectiveness of autonomous teams. The results are presented in the following table.

| Teamwork factors	Decision making	Assigning tasks	Creating deadlines	Planning
Communication	High	Moderate	High	High
Coordination	High	High	High	High
Effort	High	Low	High	High
Cohesion	High	Moderate	Moderate	High

Table-3

The results show where the teamwork effectiveness factors are essential to consider.

VII. DISCUSSION

A. Contributions:

The survey conducted to answer RQ1 has enabled us to identify the cultural differences that have an impact on autonomous teams in agile GSD. This can be used to improve the quality of autonomous teams to improve productivity and quality of the product. Until now most of the research has been concentrated on the effects of cultural differences in GSD and on how minimize those effects to improve the benefits of GSD. Through this research the autonomous teams can be improved from the member level to improve the benefits of GSD. By answering RQ2 the factors that have impact on the teamwork of the autonomous teams are identified. This can be used to further improve the effectiveness of autonomous teams.

Fig 2-Research Outcomes
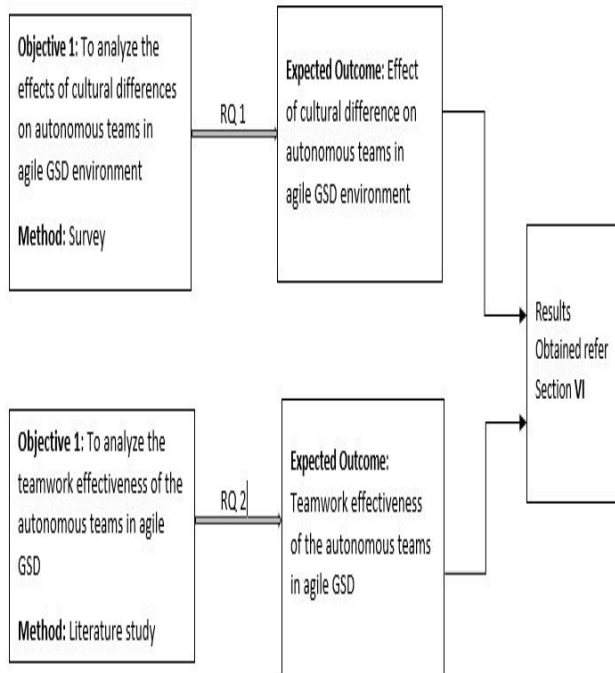
B. Threats to validity and limitation:

Internal validity: The validity threat that can be encountered is the analysis and interpretation of the data gathered. The data gathered form the respondents if analyzed incorrectly it may not produce the required results. And the papers gathered in the literature may not be accurate for the intended study and the researchers may be missing out on other quality papers because of the time constraints.

External validity: The main threat to the validity is the reliability of the information gathered and the amount of information gathered for the research. Because of the time constraints there is a limit to the amount of data gathered and the extent to which the survey is conducted. Because of this quality data can be missing.

VIII. SUMMARY AND CONCLUSIONS

GSD is used widely in organizations around the world. But there are drawbacks to using GSD. Research has been carried out to minimize the impact of geographical, temporal and cultural differences in GSD. But limited research has been done on analyzing the impact of these differences on team autonomy in agile GSD environment. In this study we have identified the cultural differences that have an impact on the autonomous teams. And we have evaluated the teamwork effectiveness of autonomous teams. Survey method was chosen to answer identify the factors that have an impact on the

autonomous teams. The data gathered was analyzed using grounded theory. The results show the factors that have a positive and negative impact on the autonomous teams. This information can be used to model the teams in such a way that the impact of the factors can be minimized. The team work effectiveness is evaluated by identifying the factors that determine the effectiveness. These factors are then analyzed against the autonomous teams. This can be used to improve the performance of the team to produce a better quality product.

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