# Geographically Distributed Software Quality Assurance Team Management

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**ABSTRACT:** Globalization has embraced the world business, even the software development industry also affected. In order to exploit the universe talent there is major trend of offshore development, testing and for other quality assurance activities. Organization in order to save costs, and use specialized expertise has focus on distributed software development and quality assurance practices. Along with certain advantages there may be certain loopholes and problems, if the distributed process and teams are not managed in a proper ways. The focus of the study is to provide a framework for understanding and supporting the management of geographical distributed quality assurance teams. The proposed framework stresses the need of effective team organization, configuration management, collaboration, coordination and communication across team members. The study also evaluates the performances of team geographical distributed teams while applying these parameters.

**KEYWORDS:** Quality Assurance, Geographically Distributed software Quality Assurance (GDQA), Configuration Management, Coordination, Collaboration, Communication.

## 1 BACKGROUND

Globalization has effects on all aspects of life, from how a person spent a day to complex business activities. Due to far reaching technologies, most of the entities and functions of life has changed to take advantage of the shift and add value to their business. Technology and Globalization also has impact on business. Now the small business has the capability to reach in far areas of the world. Software development industry also witnessed dramatic and revolutionary shift in ways it do business, perform process, and manage people. New technology equipped the modern business to reach in far-flung areas to access the resources, skills and competencies, which considered essential for the business [1].

In recent years software vendors have emphasize on cutting the cost of software development while there is also increase in concern of quality of software products both from customer and organization perspectives. Keeping in view of globalization and availability of modern technologies a modern software development paradigm is offshore and distributed development, which also tends to promote geographical distributed software quality assurance [2]. This can be evident from many cases of off shoring and outsourcing of software development and quality assurance activities to low-cost countries like India, China, Russia etc. This distributed and offshore development paradigm shift the development and testing from co-located teams to geographical distributed teams, which impose certain challenges and new agenda of research for effective management of such team [3].

Geographical distributed quality assurance (GDQA) can save money, help to market early and provide skills that are not available locally. There is need of flexibility in the process of development and quality management to support and working of such teams. It is customary to develop new process and tools for the support of such teams and even a new model of working due to unique challenges induced by demands of flexibility and speed in new paradigm [4].

In order to lower the costs of development a new paradigm of software development is development and testing in distributed and offshore fashion. The basic theme of offshore and distributed development and testing based on the

utilization of viable talent at lower prices from different parts of the world.  It also tends to exploit geographical distributed talent in an efficient and productive manner at lower costs. This distributive approach to quality management made the software quality assurance to a more complex level. Handling of such a large geographically distributed team for tracking and managing quality for variety of diverse projects not proven to an easy task [5].

Geographically Distributed Development is common approach within the software development organization nowadays. Despite tremendous concern in quality of software product budget still fall short for the required efforts. In order to attract best talent and save cost organization shifting towards globally distributed team of software development. In order to manage quality assurance team there required greater agility in quality management. Due to shortfall of budget for quality, efforts and staff required for quality management. One solution for organization is accelerating quality management practices by leveraging quality practices [6].

## 1.1 CHALLENGES WHILE MANAGING DISTRIBUTED TEAMS

There is a transition from in-house to distributed development result in save cost and high skill and talent availability. A lot of expertise and commitment required in managing distributed team otherwise it might not work well for the organization results in failure of projects due to loss of time and quality of finished products [4] . There are certain challenges while managing distributed team, some listed below;

- Sometimes distributed team members not treated as true as true member of team or treated differently.
- Usually there is insufficient communication between the distributed members. Team management should think beyond medium and tools. There should be adequate process in place for effective interaction, collaboration and communication for team members [7].
- Distributed team members lack required skills to operate in distributed environment [3].
- Distributed team members falls below the required motivation result in effect on quality of work and product and high turnover. Its responsibility of management to train the team members in required skills as well as skills required to operate in distributed fashion [8].

In a traditional environment most of their efforts of team not aligned with the requirements. Due to poor communication and collaboration, many unattended changes to the product took place due to testing process. Role of quality persons limited to testing department only. Real value of quality management team usually ignored [5].The net result is that integrity and quality of the product is at risk. In order to reduce risk in distributed quality management its necessary that all the quality team members and others teams are in close collaboration and in synchronization with each other. Every team member should have a common focus and stay in touch with requirement changes. Both development and quality team members should act according to changed requirement [9].

## 2 MATERIAL AND METHOD

Managing distributed team is complex phenomenon and lot of ingredients included in the framework. Understanding the fundamental of software quality practice in distributed environment is very important before their implementation.  In order to limit the scope of our work we focus on organization of the team, Configuration management, coordination, collaboration and communication of geographical distributed team members.

## 2.1 TEAM ORGANIZATION

Distributed quality management team also offers many advantages beyond attracting skills and cost saving. It allows simultaneous parallel activity execution result in more time to market. Each team members allocated fixed portion of code for evaluation, allowing the quality assurance activity in parallel. With the help of independent task intercommunication overhead can reduced, allows each member to act autonomously and progress without substantial hinders. Effective use of distributed team can provide lot of advantages for the organization in term of [10] [11];

- Overlap activities provide opportunities for continuous 24-hour working.
- Reduce time to market
- Better use of skills of team members
- Add global prospective
- Improved software quality through multiple skills integration into effort
- Low operating overhead

There is also some problem with distributed team if not properly organized. If distributed teams not properly managed, whole project suffers. For geographical distributed team members minimum interdependence required in order to avoid risks involved in communication and collaboration. Situation becomes more complex with existence of team in different time zone result in minimum overlap of working hour. This may introduce potential problem in team interaction and communication [4].

One solution to this problem is shift work. All the locations involved to work for 24 hours around the clock. Luckily, software artifacts are capable to transfer across the location exploiting modern communication capabilities. Continuous working in shift may reduce the problem arises due to existence of team in different time zones. However, it also requires some adjustment as [4]:

- Divide the software project artifacts in semi-independent activities.
- Assign it to distributed team members who can work on it independently.
- Explore possibility of simultaneously start of as many activities as possible.
- Minimize independence between activities.
- Establish transparent communication between tem members.

Aim of distributed team is to promote concurrency by assigning task of system evaluation to separate tem members. Each member proceeds autonomously on his or her allotted work. In a traditional environment, system work decomposed into sub systems and assigned it to team.

Each sub system assigned to specific group for evolution, which also divide it into number of modules for testing and quality assurance activities. This type of decomposition performed for collocated team. There are different requirement for geographical distributed teams. In case of distributed team the team require interface at the sub system level where evaluation and quality assurance of a single sub system carried out by individual team members. There is also need for close interaction and collaboration if the distributed team member has to work on shared tasks. Virtual teams' scenario is presented in figure to depict the two members working from different sites existing in different time zone. Team members are cooperating for quality management tasks over the sub system. One member is developer and other is testing the system. Each member has the chance to review each other work shown in the form of dotted lines. Documents should flow among team members [12].

All the team members can share test cases and test data to increase collaboration with each other. Every tester write his own test cases and test data and after comprehensive review share it with other team members for collaboration and review in order to find more defects and quality activities .It allows concurrent execution of quality assurance activities by decomposing tasks into fine-grained tasks of short duration. This is actually introducing concurrent cooperative quality assurance practices at the individual task level.

## 2.2    CONFIGURATION MANAGEMENT

With the emergence of geographical development and quality assurance activities it becomes very necessary that all the team members have support of configuration management tailored to adjust their needs and requirements.  Theses distributed team members have to support the distributed team members that promote synchronization and centrally controlled [13]. We recommend fallowing CM architecture for distributed team.

- Version control:  All the documents, files versions and variants should available to all the concerned team members in such a way that it promotes retrieval, access and comparison in an easy way.
- Build management: All the generated files should be kept updated and can be maintained from where ever required.
- Release management: All deliverables should incorporate into product release and integrated.
- Change management: All the changes can be tracked and managed from wherever required.
- Reporting status: All the members can track the information relating the change.

Document or knowledge management related to creation, capture, about project activities, tasks, goals, problems, solutions, methods, process and solutions. Without face to face interaction knowledge creation is difficult. Without knowledge available it becomes difficult for the team to collaborate and establish knowledge about domain. In a distributed environment where a shared knowledge is very necessary but creation of this knowledge is even more difficult in this environment. Due to changing role, changing relations and properties of electronic communication development of documentation and knowledge is very difficult in distributed environment [14].

Document management in distributed environment is necessary as it is very difficult to access the person for relevant knowledge seeking. Without adequate document and knowledge management team member involve in enhanced communication and collaboration efforts results in waste of resources and time of team members. Increased level of communication has its own pitfalls when knowledge gained through these efforts. There should system for document management for test scenarios, test scripts, test execution and test results. Test management tool is necessary with support of accessibility from multiple locations.

These categories can be refined to serve the team. The structure and size of documentation depends upon many factors like project size, team structure, physical location of team members etc. Centralized repository manages documents in such accessible to all team members [15]. There also proper access mechanism to avoid inconsistencies to concurrent change in documents. One write read many strategies would helpful. At one time only one edit should allow. Ensure each member have access to latest version.

## 2.3 COORDINATION, COLLABORATION AND COMMUNICATION

Geographically distributed teams should overcome the barriers to communication in term of distance time and culture. If it is feasible, conduct meeting to provide face-to-face interaction with team members. If team members are in different time zones use appropriate schedule that all team members can participate in meetings and interaction with each other.

Team members from different cultures also feed difficulty communicating with each other. Different words and conventions have different meaning in different countries and cultures. It requires appropriate understanding of cultural context and without understanding of cultural context there are chances to make errors and a lot of risk [16].

In order to overcome these problems you have to invest more in communication as compared to traditional environment. Context of communication for distributed dispersed team is different and complex and require continuous interaction among team members. Management has to provide all the opportunities and resources to provide infrastructure for better interaction and communication among team members. Among many choice management has to invest in telecommunication strategies as teleconferencing, videoconferencing, web-based conferencing, and online chat software.

The basic objective of our framework is increase the coordination among team members. Multimodal communication technology helps to increase coordination and collaboration among team members. Use of multimodal communication technology facilitates the collaboration and coordination among team members. Distributed team members should also bound with each other just like co located team members. Try to establish strong bound among tea members and it is the responsibility of management to involve all the team members in close communication with each other. It can prove costly but it cannot avoid.

In order to cope with problems and challenges in distributed environment communication is very vital but it is also not simple in distributed environment. Without appropriate infrastructure it is not possible. With absence of informal and face to face interactions team members may suffer with problem of lack of trust, creativity, decision quality and other management issues.

Without support of appropriate communication distributed team members may not get appropriate insight of project goals and objectives and even may lead to penalization of the project progress. Management here should not think in term of "penny wise and pound foolish" strategy as it could result in huge return on investment. Once the working relationship improves, cost automatically tends to decline. Interaction, collaboration and communication among distributed team members are very vital for the success of the project as compared to traditional in-site developments and quality management practices [1].

Synchronize the tasks of all team members to review what they did yesterday and what they do today preferably at the beginning of each morning. Make sure everyone believe that everyone working [17]. Team lead should encourage the team members to provide feedback and help others. This type of meeting helps to synchronize work and to realize that they are involved and part of an integrated work.

It also helps the team lead and manager to realize that each team members is performing, challenges and problem of individual team members. These meetings should be short and focused. Long meetings may bore where members pay little attention to others. Personal meeting with team members help to know about your team members and motivation of team members. If possible, plan a visit to meet individual team members as frequently as possible. Devise a plan to mix team members by arranging cross-site visit or at least a common tour to some recreational resort [18]. This help the team members to get know each other personally and share work dynamically. They have the opportunity to share challenges, experiences about day-to-day operations.

Standardize the communication and manage from single location. Keep fallowing points in your mind regarding managing site of distributed team:

- Single sited platform should be accessible to all team members from all sites. Access time and accessibility response should not frustrate tem members.
- All the team members can work under the same methodology and can customize according to individual needs if there is some need of individual team members.
- All the team members in a position to seek help from any team members. This help to seek guidelines from other team members and incorporate direct feedback mechanism among team members.

Make sure no team member feels disconnected from actions. Sometime some member has may have close interaction due to different reasons as due to geographical location, because of more interaction with team leads [19]. Whatever the reason, member should not think that he is isolated from the action. Number of actions can help to avoid such problems:

- Make sure all team members have direct access to individual team members and other team members like developers.
- Arrange video meeting with team members that neither are nor frequently related.
- Try to involve them in process improvements, challenges handling.

Distributed quality assurance team members face with the problem of collaboration among team members, management and stakes holders. Collaboration among co located team is difficult task and in distributed environment due to its inherent complexity it becomes very difficult for the team members to collaborate to presence of different type of diversity. There are fallowing reason of lack of collaboration and coordination in spatial dispersed team [20].

- Spatial dispersion of team members is the main source of lack of coordination and collaboration.
- Temporal dispersion or different time zone added another layer of complexity for the promotion of coordination and collaboration among distributed.
- National diversity relates to different norms, communication routines, and different interpersonal skills also contribute towards the lack of coordination and collaboration.
- Due to problematic task coupling and inter-functional conflicts in distributed environment also source of lack of collaboration and coordination.
- Lack of face to face interactions and dependency on electronic communication is also major reason of lack of coordination in distributed environment.

Due to spatial, temporal and cultural difference it is very difficult for the management to establish collaboration among team members in distributed environment. Due to time zone differences for the spatial dispersed team it become very difficult for the management to establish collaboration but it is more important in distributed environment to build trust and share work. There are many source of lack of collaboration among team members like cultural differences; language barriers and lack of face to face interaction reduce the chances of collaboration work among team members [4].

In order to establish collaboration among team members it is essential that there is some mechanism of knowledge share among team distributed team members. Our proposed framework also includes the document management for use team members promote knowledge sharing. Due to document management team members develop collaboration among themselves for task, help and role clarification.

## 3   RESULTS

Many organizations rely on distributed quality assurance practices. Most prominent among them are IBM, Xerox. In order to evaluate the performance of the teams, data collection methodology should consistent, standardized and systematic across all distributed teams and team members. As team members are not physically at the same place attention should paid to performance measure.

We want to apply observation and questionnaire for data collection across the distributed team members. Data collection methods should remain consistent for all the team members. Next important question is what should measure and how to support the evaluation. Literature review suggests that communication, information exchange and collaborative behavior are important aspects of team performance. These dimensions are more important in distributed environment due to lack of face-to-face communication. Understanding of individual role is also important. Standardized observation applied in order o get uniform feedback and responses from team members.

We try our best to apply uniform data collection methods. We try not to induce any bias in data collection. We receive 264 out of 500 responses from team members with 52 % response rate. Out of 264 we only use 245 responses due to corrupted or lack of appropriate response. Next we move towards interpretation of data. Microsoft excel and statistical used for this purpose.

Hypothesis 1: Proposed framework improves distributed team productivity.

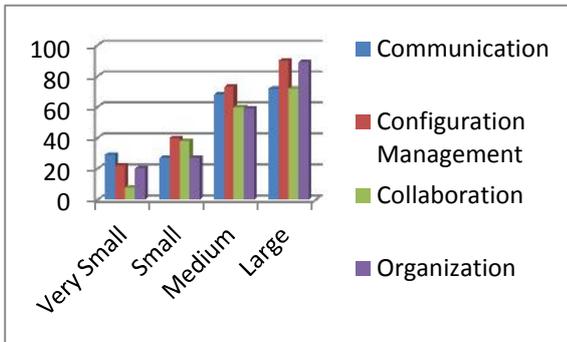Hypothesis 2: Proposed framework improves team efficiency.



*Figure 1 : Percentage productivity improvements in different sized projects*
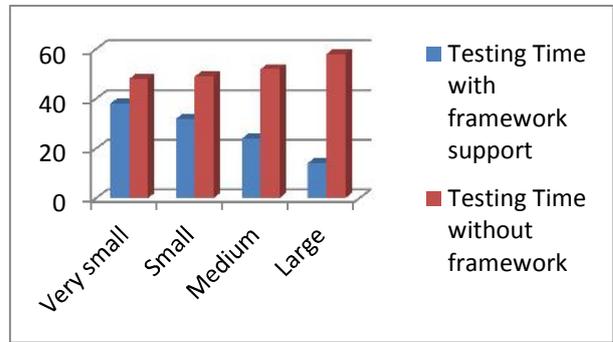


*Figure 2: Time saved of team members*

We can easily infer that with application of proposed framework in different sized projects testing efforts tends to reduce due to support of other quality assurance practices and effective management of team. Due to increase collaboration, communication and document management teams manage their work effectively. Due to support of other quality assurance practices team have to spent little time in managing the testing process. We can infer that team required less time to communicate, feedback and collaboration with each other when supported with proposed framework as compared to team without support of framework.

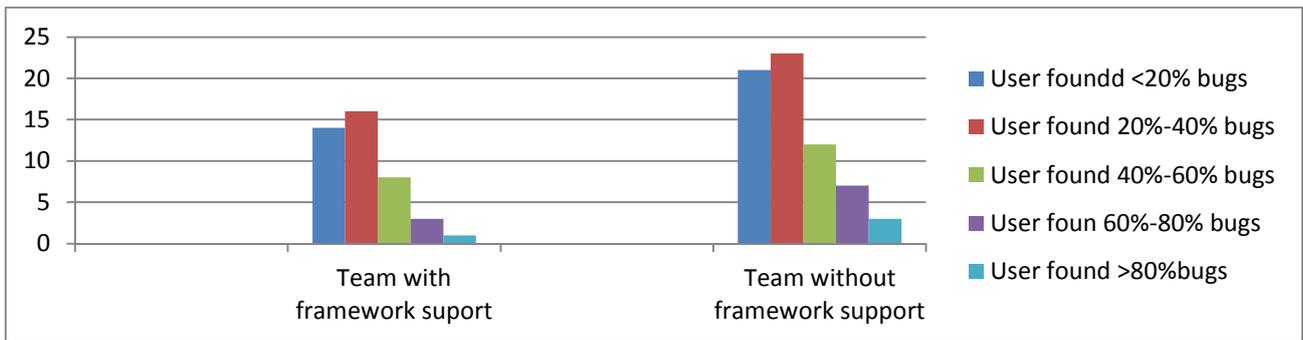**Hypothesis 3: Proposed frameworks improve quality of the product.**



*Figure 3: Defect management efficiency*

## 4    DISCUSSION

Through this study, we get greater appreciation of quality assurance activities employed by distributed quality management team managed by proposed framework. We are able to collect certain evidences of successful activities of distributed team, which leads to improved quality management practices. We also able to quantify certain activities and practices in order to objectively assess the virtue of the proposed framework.

Proposed framework revolves around the notions of effective team organization, configuration management, coordination, collaboration and communication of team members. Proposed frame work for effective management of distributed quality assurance team management try to overcome different problems present in traditional distributed

environment. Proposed framework concentrate on some important aspects like communication, collaboration, coordination etc. with fallowing benefits.

- User has more perceived value of the final deliverables when quality assurance team managed with support of proposed framework. There is no alternative for customer satisfaction. With implementation of proposed framework quality of the products improve.
- Document management reduces time in communication, feedback and over collaborative tasks.
- Proposed framework reduces testing efforts of individual team members due to effective communication, feedback and collaboration over tasks.
- With the increase in project size, proposed framework has more subtle effects.
- Proposed framework improves team productivity, efficiency and helps the management to utilize resources in an appropriate way.

## 5    CONCLUSION

Geographically distributed teams prove to be cost effective and beneficial in many respects like cut of cost and attracting universal talent. In fact management of geographical distributed teams is not as straight forward and simple. Quality assurance is very critical and management of quality assurance teams that is geographically distributed is even more hazardous. With the proper use of configuration management of the product and knowledge management the team member can collaborate, communicate and coordinate in an effective way. This result is that positive impact on performance of such teams. Without coordination, collaboration and effective communication the productivity and performance of such team suffer and the decision to go for globalization may bounce back.

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