Elicitation of Communication Inherent Risks in Distributed Software Development

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Abstract—The lack of risk management, communication and understanding of the requirements are actually the main factors related to the low rate of success in software development, more specifically in distributed projects given the characteristics of this type of development. Considering distributed software projects, the main goal of this paper is to show communication inherent risks empirically identified in such type of project, and the strategies and recommendations adopted to mitigate them. For example, we found that to solve misunderstandings that may occur due to the cultural diversity and language we must encourage frequent communication. This frequent communication does not only increases the communication effectiveness, but also develops the cohesion among the distributed teams, resulting in an improvement of the informal communication and establishment of the confidence among members of the distributed team. These findings were obtained from an exploratory empirical qualitative research that collected interview data from project leaders and managers from several software projects from distinct companies. Our findings contribute to a better understanding of the influence of communication process in DSD. It also contributes to the industrial practice so that they can use the results to improve the communication management, minimizing potential problems.

Keywords – Risk Management, Distributed Software Development, Communication related risks, Empirical research, Qualitative research, Communication strategies, Communication recommendations.

I. INTRODUCTION

In the last decades the globalization promoted, and still promotes, great changes in several economical areas, including software development related areas [1][2]. Competitiveness in the national and international markets, with more and more demanding clients, more complex demands associated to communication means and technological resources in increasingly evolution, gave origin to the formation of Distributed Software Development teams, and created opportunities for restoration of the traditional ways of working in order to make use of the competitive advantages offered from different nations.

In this globalized context, where the corporations distribute their development efforts, is the Distributed Software Development (DSD) [3]. For Carmel [4], the growth of this new organization modality and team disposition are related to the companies interests in get the more specialized professionals, reduce the development costs, have global presence and reach more proximity with their clients.

However, this new scenario generates new challenges for the common software development process, because it introduces new variables, like: geographic distance between the people, virtual communication, time zone and cultural differences. The adoption of distributed development brings benefits to the organization. However, it imposes other challenges, like the risk of failing achieving the project goal. The results of practical experiences allow to verify that the spatial and temporal separation of the people involved in a DSD project affects directly all the team and the costs of the project in progress, making its realization expensive and arduous due to numerous problems, since the communication difficulty with determined languages till the time zone of the involved teams [5].

It is possible to realize that the interest of the enterprises in DSD is becoming evident when is verified that 300 from 900 enterprises member of the NASSCOM (National Association of Software and Services Companies), in India, work with DSD [6]. However, in his studies, Binder [7] says that although a great number of companies are using DSD projects, less than a third of them have effective practices established for helping the managers and teams to minimize errors and lower its costs in this environment. Pichler [8] points that many DSD teams perform presence project practices and do not uses specific DSD practices, heading for failure. DSD projects, in addition to inherit the same problems than co-localized projects, have a series of peculiarities, situating them in an acting field of uncertainties and several inherent risks.

From the software projects management viewpoint, one of the main challenges of DSD since its beginning has been the risk management/analysis [9]. Taking as reference Kliem [10], all the advantages brought by the DSD could be lost, case the project risks not be managed, leading the corporations to financial losses. This way, to manage the challenges and mitigate the risks is a recommendation for try to minimize the DSD impacts [11]. Although the DSD offers numerous competitive advantages, is necessary to know the risks related to this development mode, because do not know and mitigate them could lead the project to the crescent list of projects that failed.
II. RISK MANAGEMENT IN SOFTWARE PROJECTS

The importance of software is growing day by day, closely with the technology progress. So, the appearance of new projects also had increased. In the other hand, these projects had not been followed by project management practices properly structured and incorporated to the company processes, and this fact had reflected negatively in their results, as seen in the “Chaos” report, conducted by the Standish Group, in which the rate of projects finished with unsatisfactory results (failure or partial success) continues relatively high (68% in 2008) [12].

The software development is a complex activity, which involves factors like technological innovations and constant customer requirement changes [13]. An efficient risk management makes more easy deal with the problems and assures that they do not lead to an unacceptable budget or delay in the schedule. Therefore, identify and deal with the risks in the beginning of the development lower the costs in long term and help to prevent disasters, developing strategies able to reduce them [14].

In Brazil, a research published in 2001 demonstrates that only 11.43% of the 446 researched companies perform the risk management process [9]. In this direction, an effective risk management is evidenced with fundamental importance for the software project success. Risk managing is a primordial activity for any project executioner organization, due to any activity introduces risks and compromises the financial costs invested on the development. An anticipated risk analysis is important; normally is easier, cheaper and causes fewer interruptions make changes and correct work efforts during the initial stages than in posterior stages of the project [15].

A. Risk management in distributed software development projects

Accordingly with Erickson and Ranganathan [16] the DDS approach affects significantly application development projects and increases the need for a strong project management, due to the communication reduction, cultural misunderstandings possibility and risk of fault of the comprehension of the real project objectives. In this line, Sakthivel [17] says: “Systems developed by a team of people from different countries, talking several languages and separated by the time zone and distance, have high risk”. The author also highlights that the advances in communication technologies also allow virtual work in DSD projects, however, In recent researches in the fields of psychology, organizational behavior, management and communication fields points that work in distributed environments has limitations.

Prikladnicki et. al. [18] points out that “risks management in DSD is an important and necessary activity”. According to the authors’ opinion, the work in a DSD environment is more problematic then in a centralized environment, and the effective management of risks never can be lowered. Kliem [10] defends that all the advantages brought by DSD can be lost if the project risks not be managed. So, we can say that DSD projects represent particular risks that need a more effective managerial attention.

III. COMMUNICATION IN DISTRIBUTED SOFTWARE DEVELOPMENT

In distributed projects, communication is the basis to define how will be passed the information to the stakeholders involved in the project. Several researchers like Carmel [3], Audy and Prikladnicki [9], Farias Junior [19], among others, ensure that communication is a fundamental factor for the distributed projects development. In order for this communication to be effective, is needed to have efficient ways that exceed the barriers imposed by the development made in different locals. The definition of interfaces of formal communication can be obtained by well-defined process models, with well-established marks and metrics. Prikladnicki, Audy and Evaristo [20] say that the communication processes need to be adapted to the characteristics of every organization, and can change on each project stage, as they start to include teams with different cultures.

An effective communication in distributed projects builds the formal and informal confidences between the team colleagues. With the DSD growth, the managers, engineers and executives had lived experiences with professionals of different technical, social and cultural levels. The possible solutions to these differences are extremely complicated locally, where exists face-to-face communication, because the differences of language, technical terms and social approach forms difficult the communication. These problems identified in local environments raise significantly when in a distributed environment, because the means of communication like e-mails, chats, phone calls, are not so rich as the face to face communication [21].

IV. METHODOLOGY

The main aim of this research was identify the principal risks inherent to the communication process on DSD. In this context and based on the available literature about the thematic covered in this study. The main and fundamental goal was in fact to develop, to clarify and to modify concepts and ideas, having by target the maturation of already existent theories. This way, was chosen to do a field research with qualitative and exploratory feature.

A. Data collection techniques

The data collection technique used was the application of interviews done via Skype with the respondents using as recording resource a Skype compatible plugin, called Install Call Graph, in order to facilitate the transcription of the collected data. The interview guide has 24 questions, dealt with questions directed to the thematic studied in this work, and was done in the period of November 23 to December 03 of 2011.

An important result and preliminary information is that 47% of the companies where the respondents works do not have any quality certify (ISO3, CMMI2 or MPS-BR3). Among

1 http://www.iso.org/iso/home.html
2 http://www.sei.cmu.edu/cmmi/
3
the respondents, five have their organization certified on CMI, 3 (three) have ISO 9001 certification and 7 (seven) do not have implanted any quality certification.

B. This aspect is very relevant, because many studies have emphasized the necessity of these companies in adopting good practices of risk management in DSD according with the market standards. Characteristics of the participants

The 12 research participants were managers and leaders of DSD, selected according to their function in the project. We obtained information about their educational degree, experience time on software development, experience time on distributed software projects, among other information. 50% of the respondents have experience in distributed software development bigger than 4 years and 75% of the respondents act on the management level. The information was given always respecting the politics of privacy and confidentiality. Concerning to the education level, all the respondents are of the informatics area, which 42% are graduated, and 58% are post graduated. In this sample, only one of the respondents has the PMP (Project Management Professional) certify.

V. RESULTS

In this section we show the results of the research about inherent risks to the communication in DSD projects. These results were extracted from the literature review, as well as from the interviews with managers and leaders of DSD projects.

A. Communication Inherent Risks in Distributed Software Development

The communication is seen in the literature as a key factor to the project success (e.g. [7], [17], [22], [23], [24], [25], [26]), but it is difficult to be performed in a distributed environment. According to Farias Junior [23], the physical distance has direct impact over all forms of communication, being them: formal or informal. Where the people are not geographically separated, the communication could not be sufficient [27] and many times the communication occurs in a not very productive form. Particularly, we see this in software development equips where in the initial stages of a project much communication is made necessary [28].

The risks classified in the communication category include the challenges related to the physical distance, the loss of confidence between the teams, the difference of cultural and linguistic orientations and the temporal distance. On the Table 1, we observe the main mapped risks, firstly on the literature and then related to the risks mapped on the respondents’ speech. To map the respondents’ risks, each interview was individually analyzed and then the risks listed on the Table 1 were extracted and summarized. However, was felt the necessity of extract some recommendations as response to these risks. These recommendations were conceived also by the literature base and the experience of the respondents to describe recommendations applicable on real sceneries. The recommendations are detailed on the sub-section 5.B.

Table 1 - Relation between risks Literature and Interviews

<table>
<thead>
<tr>
<th>Risks</th>
<th>Literature</th>
<th>Interview</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication Effort increase</td>
<td>[25], [29], [30], [31], [32]</td>
<td>Respondent 1</td>
</tr>
<tr>
<td>Delay in response</td>
<td>[33]</td>
<td>Respondent 10</td>
</tr>
<tr>
<td>Lack of Trust</td>
<td>[33], [34], [35], [36], [37]</td>
<td>Respondent 1</td>
</tr>
<tr>
<td>Lack of Face to Face meeting</td>
<td>[34], [38], [39]</td>
<td>Respondent 1</td>
</tr>
<tr>
<td>Lack of inter-personal</td>
<td>[39]</td>
<td>Respondent 5</td>
</tr>
<tr>
<td>Communication Frequency</td>
<td>[24]</td>
<td>Respondent 10</td>
</tr>
<tr>
<td>Reduce</td>
<td></td>
<td>Respondent 11</td>
</tr>
<tr>
<td>Lack of informal communication</td>
<td>[29], [40], [23]</td>
<td>Respondent 3</td>
</tr>
<tr>
<td>Terminology difference</td>
<td>[38]</td>
<td>Respondent 9</td>
</tr>
<tr>
<td>No frequent feedback exchange</td>
<td>[25]</td>
<td>Respondent 3</td>
</tr>
<tr>
<td>Lack of an appropriate</td>
<td>[25], [34]</td>
<td>Respondent 4</td>
</tr>
<tr>
<td>Communication Infrastructure</td>
<td></td>
<td>Respondent 5</td>
</tr>
<tr>
<td>Lack of Native/Business</td>
<td>[23], [25], [37], [38]</td>
<td>Respondent 1</td>
</tr>
<tr>
<td>language skills</td>
<td></td>
<td>Respondent 5</td>
</tr>
</tbody>
</table>

B. Recommendations

We introduce some recommendations as response to the identified risks both in the literature and in our empirical study. The recommendations are based in questions related to the communication that appear due to the physical distance between the people, virtual communication, time zone differences and cultural differences. These recommendations were extracted from the literature and the interviews in the field research. They are described below and indicated in short as “R1”, “R2”, and so on.

(R1) To encourage frequent communication

This practice is useful to solve misunderstandings that may occur due to the diversity of the culture and language among the distributed teams. This frequent communication does not only increases the communication effectiveness, but also...

\[1\] http://www.softex.br/mpsbr/_home/default.asp
develops the cohesion among the distributed teams, which results in an improvement of the informal communication and establishes the confidence among members of the distributed team.

(R2) To establish an appropriate communication infrastructure
This practice is useful to establish the confidence among the distributed teams, to solve the uncertainty or unpredictability in the communication. Appropriated communication infrastructure also is necessary to reduce the lack of presence or “face to face” reunions. The infrastructure of adequate communication raises the communication quality, in order to minimize the impact of the absence of the “face to face” communication.

(R3) To promote the socialization between the project team members
It is important to have socialization in the beginning of the Project, where the new team members are introduced in the project, because this practice raises the effective communication among the distributed teams. Socialization among the distributed teams also increases the cohesion and consequently raises the informal communication. Furthermore, increases the confidence among distributed teams and the interpersonal relationship among teams.

(R4) To encourage effective communication through the adoption of tools and techniques
In order to increase the communication between team members is important frequent use of effective communication tools. The teams in remote locals need to share their knowledge, practices and socialize one with other by formal and informal communication, which results in mutual confidence among the distributed teams. The necessity of face-to-face meetings lowers because of the frequent communication by effective communication tools. This practice also is useful where there is a great cultural diversity.

(R5) To promote frequent visits among distributed members to support trust building
In the DSD context is interesting to plan frequent travels to visit remote teams, especially where the teams are globally dispersed. This attitude is for maintaining the mutual understanding among them. Furthermore, this practice aims to promote a good relationship and trust between the teams.

(R6) To encourage the use of the standard language of the project
As described, the language barrier is one of the main problems in GSD, so, is recommended the use of common language on practice. This will solve misunderstandings between the teams and misinterpretation of requirements. Wrong interpretation can cause loss of some important information which reduces the product quality, therefore is better to use the standard language adopted by the project.

(R7) To promote informal communication
The informal communication among the distributed teams must be encouraged, because it does not just solves misunderstandings, but also is useful in the sharing of the knowledge practices between distributed teams. Informal communication is useful in the confidence building. Also improves the socialization and inter-personal relationship. The informal communication in GSD can be done by synchronous/asyncronous communication channels.

(R8) To promote the cultural awareness
Cultural conscience between distributed teams is useful to solve terminology differences and misunderstandings between team members. This practice has the objective of institutionalize the information of all teams for the project stakeholders.

(R9) To promote the adoption of groupware applications
The utilization of groupware applications (like teleconference/videoconference tools, Microsoft Exchange, project management tools, Dropbox, Wikis, Mendeley, etc) must be promoted.

C. Relation between the listed risks and recommendations.
After list the risks during this research and then suggest the recommendations, was necessary make the relationship between both – risks and recommendations. This relation has as objective to identify actions to minimize the inappropriate occurrence of these risks.

Table 2- Relation between risks and recommendations

<table>
<thead>
<tr>
<th>Risks</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication effort increase</td>
<td>R1, R2, R4, R9</td>
</tr>
<tr>
<td>Delay in response</td>
<td>R1, R7</td>
</tr>
<tr>
<td>Lack of Trust</td>
<td>R1, R2, R3, R4, R5, R7</td>
</tr>
<tr>
<td>Lack of Face to face meeting</td>
<td>R2, R3, R9</td>
</tr>
<tr>
<td>Lack of relationship inter-personal</td>
<td>R2, R3, R8</td>
</tr>
<tr>
<td>Communication frequency Reduce</td>
<td>R1, R4, R9</td>
</tr>
<tr>
<td>Lack of informal communication</td>
<td>R1, R3, R4, R7</td>
</tr>
<tr>
<td>Terminology difference</td>
<td>R1, R6, R8, R9</td>
</tr>
<tr>
<td>No frequent feedback exchange</td>
<td>R7, R9</td>
</tr>
<tr>
<td>Lack of adequate communication infrastructure</td>
<td>R2, R4, R9</td>
</tr>
<tr>
<td>Lack of Native/Business language skills</td>
<td>R6, R5, R8</td>
</tr>
</tbody>
</table>

Label: R1 = Recommendation 1… Rn = Recommendation N

VI. FINAL REMARKS AND FUTURE WORKS
This research had as main aim to verify how the managers and leaders of project deal with the question of the risk in DDS projects with focus in the communication. This way, using a research tool applied as questionnaire, was tried to get answers to the following research question already cited in this paper: What are the principal risk factors related to the communication category that are most common in DSD?

Between all the obtained answers, after the analysis, we observed that managers, generally, are concerned about the presented risk factors. Although most of the companies which the managers make part do not have a methodology for risks
management structured and sustained by standardized procedures and forms, was observed the beginning of actions in this sense. Was found that exists interest for treatment of risk factors and that managers and leaders of project have science of their relative importance, but the execution of some form of management of these factors is still small.

Was possible see also that, in distributed environments, if the software processes are not well defined, and if the teams are not prepared to work in this context, the risks increase substantially. In the investigation of risk reacting strategies, we observed the tendency to adopting more preventive strategies, as well as we raised a series of relevant actions that are taken to fight them which gave origin to some general recommendations.

Finally, with the intention of contribute with researches that follow the same adopted approach, is important to highlight that exists limitations related to the adopted paradigm, seen that the qualitative paradigm is subject to human limitations by using information based on people experiences. As perspective for future works, stay the verification of another risk situations existing in DSD, the analysis of risk solving techniques, the analysis of the risk factors by the product bias or project final service.

REFERENCES


