Requirements Negotiation and Conflict Resolution in Distributed Software Development
A Systematic Mapping Study and Survey

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This thesis is submitted to the Faculty of Computing at Blekinge Institute of Technology in partial fulfillment of the requirements for the degree of Master of Science in Software Engineering. The thesis is equivalent to 20 weeks of full-time studies.

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Abstract

The main aim of this thesis is to explore the industrial practices of requirements negotiation and conflict resolution within distributed software development. The motivation for this study is to get insight of the industrial practices in particular interventions (Communication tools, Models, Communication media) that used by practitioners to resolve requirements negotiation and conflicts resolution between clients and suppliers, since many researchers purposed interventions in the literature for requirements negotiation and conflicts resolution in distributed software development.

Context: In Requirements Engineering, requirements negotiation and conflict resolution are crucial activities to achieve a common ground between clients and suppliers, it is considered as one of the crucial factors for delivering successful software. However, the shift from traditional collocated practices to a distributed environment offers both benefits and drawbacks which were studied earlier by researcher, but surprisingly there are few studies with insight of exploring the distributed requirements negotiations and conflict resolution practices. This research investigates the state of requirements negotiation and conflict resolution activities in distributed software development with an insight on their importance and relevance to this research area.

Objectives: Overall goal of this thesis is to understand how requirements negotiations and conflict resolution are performed in distributed software development, knowing what are the available tools to perform requirements negotiation and conflict resolution, whether these existing tools are good enough to cope up with the industrial practices, knowing most widely used tools, methods and approaches, most importantly does the present research able to bridge the gap with in distributed software development?

Methods: This thesis study comprises of two research methodologies.

1. Systematic mapping study (SMS)- To identify the proposed interventions in the literature to perform requirements negotiation and conflict resolution activities in Industrial Software Development within a distributed environment.

2. Industrial Survey- To identify industrial practices to perform re-
requirements negotiation and conflict resolution in Industrial Software Development within a distributed environment.

**Results:** 20 studies were identified through systematic mapping study (SMS). After analyzing the obtained studies, the list of interventions (Preparatory activities/communication tools/ Models) were gathered and analyzed. Thereupon, an industrial survey is conducted from the obtained literature, which has obtained 41 responses. Effective communication media for preparatory activities in requirements negotiations and conflict resolution are identified, validation of communication tools for effective requirements negotiations and conflict resolution is performed. Apart from the validation, this study provided list of factors that affects the requirement negotiations and conflict resolution activities in distributed software development.

**Conclusions:** To conclude, the obtained results from this study will benefit practitioner in capturing more insight towards the requirements negotiations and conflict resolution in distributed software engineering. This study identified the preparatory activities involved for effective communication to perform requirements negotiation activities, effective tools, models and factors affecting of requirements negotiations and conflict resolution.

In addition to this, validation of results obtained from the literature is carried through survey. Practitioners can be benefitted from the end results of by knowing the effective requirements negotiation and conflict resolution interventions (Communicational tools/ Models/ Communication media) for early planning in distributed software development. Researchers can extend the study by looking in to the real-time approaches followed by the practitioners to perform the both activities in the direction of future studies.

**Keywords:** Conflict Resolution, Distributed Software Development, Global Software Development, Global Software Engineering, Requirements Engineering and Requirements Negotiation.

**Glossary**
1. RN: Requirements Negotiation
2. CR: Conflict Resolution
3. DSD: Distributed Software Development
Acknowledgement

I would like to thank my supervisor Dr. Michael Unterkalmsteiner for his valuable guidance and timely feedback during thesis which helped throughout my work.

I am always grateful to my brother and sister-in-law Gurudutt and Deepika, without them it would not have been possible to accomplish my masters.

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<th>Recommended changes</th>
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<td>All the identified spelling mistakes are fixed and several checks are performed to alter the spelling mistakes.</td>
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<td>Research gap for conducting secondary studies is based on the territory study in the year 2014[3]. Motivation for performing the empirical survey is based on the two articles from the year 2013[35] and 2012[6] which stressed the importance of investigation effective tools communicational tools for RN and CR activities. The Background section and related work section of this study provided the motivation for this research apart from the Research gap section.</td>
</tr>
<tr>
<td>7</td>
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<td>The intention of this research study is to structure the available research on the focus area, due to this reason there are no date limitations incorporated in database search during systematic mapping studies. These date parameters help to identify the articles back in time or articles with in particular time frame (ex. 2000-2016). But in my research since I don’t have any date related limitations the database search should append all the available articles from back in time to recent search date. However, according to my recent (06-09-2016) database search in Scopus and Inspec found the same number of articles and I have included all the relevant studies from back in time to present (till my recent database search date). Keeping these possibilities of missing crucial information in mind, survey questionnaire is provided with the text field to capture the interventions that are not covered by the literature studies.</td>
</tr>
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<td>8</td>
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1 Introduction

Software product development starts with the requirements elicitation process, where software analyst collects the requirements from clients, followed by requirements negotiations. Requirements negotiations are initiated when two or more clients disagree or when clients and suppliers miss common ground on the development of the software product with functionality and features [2], [7] and [37]. In other words, requirements negotiation is an agreement made between the clients and suppliers on developing product [19].

Practitioners and researchers claim that early requirement negotiations among the clients and suppliers is the key success factor for software development [2]. Requirements negotiations helps in building a robust software product by ensuring clear, consistent and traceable requirements [7].

Conflicts are the byproducts of the requirements negotiations, generally occurring due to poor handling of requirement negotiations [37] and [24]. Lacking of the proper requirements negotiations between the clients and supplier can lead to the failure of software product, which triggers the alarming situation for effective requirements negotiations process and another influencing factor of requirements negotiations process is, its ability to resolve complexity when the diverse clients provide brief, unclear and conflicting requirements [2].

In traditional requirements engineering approach good communication practices and face-to-face meeting eases the requirements negotiation and validation process [20]. Meanwhile convincing benefits such as low cost development, minimal resources and mainly time to market attracted multinational companies to adopt the in distributed software development., At the same time Global Software Development (GSD) supported the decision of moving to distributed development by ensuring successful software product development being in distributed geographical locations. However, this industrial shift towards global distributed development added new challenges to the requirements negotiations practices [20].

Apart from benefits, Distributed Requirement Engineering poses challenges to practitioners, since requirements engineering is one of the most communication intensive activities. In a distributed environment, requirements engineering is greatly affected by distributed clients during requirements elicitation and requirements negotiations [6]. Communication gaps among the development teams, suppliers and client’s result in project delays, quality concerns and even failures to reach user expectations [4]. It is more difficult and challenging to achieve efficiency and effectiveness in large software projects, with the distributed clients and suppliers [23].

1.1 Aim and Objectives

The goal of this Master thesis is to provide insights on requirements negotiation and conflict resolution in distributed software development.

1.1.1 Objectives

The above stated aim shall be achieved through the following objectives:

To understand the focus of research on requirements negotiation and conflict resolutions in distributed software development.

- To identify the existing research publications on requirements negotiation and conflict resolutions in distributed software development.
- To identify the proposed interventions such as communicational tools, communication media, existing models for industrial purpose to perform requirements negotiations and conflict resolution activities in literature.
- Identifying whether these interventions are validated in real time industrial context.
- To know the current state of practices in software industries to perform requirements negotiation and conflict resolutions in distributed software development by knowing the which of the proposed interventions were used by the industrial practitioners to perform requirements negotiations.
- To identify what is missing with the interventions to perform requirements negotiation and conflict resolution in distributed software development.
To identify the factors that affects requirements negotiation and conflict resolution in distributed software development.

2 Background, Related work and Research Gap

2.1 Background
In requirements engineering clients and suppliers are involved to build new software product, software engineer or system analyst collects the requirements from the clients, this process is known as requirements elicitation. Requirements negotiations and conflict resolutions are followed process after elicitation, requirements negotiation helps clients and suppliers to achieve common ground and conflict resolution helps to resolve conflict that occur due to poor negotiations. In these process both clients and suppliers communicate to resolve the conflicts that occur during the elicitation. Ensuring the software system that meets the client’s specification by avoiding missing of any critical requirements makes these process crucial [11].

Requirements negotiations and conflict resolution are termed as the important process in requirements engineering life cycle, benefits like consistency, robustness and maintainability can be achieved through these process. Having requirements negotiation and conflict resolution in earlier phases of software development saves time and money to the organization [11].

Communication plays vital role in facilitating clients and suppliers to perform requirements negotiation and conflict resolution, but this became challenging when traditional software development shifted to distributed development. In traditional approach requirements negotiation and conflict resolution processes are performed in easier ways through co-located interaction, but in distributed software development requirements negotiation and conflict resolution processes are experiencing communicational challenges [11] and [23], these communicational limitations inspired and acted as motivation for this research study.

2.2 Related Work
The growing interest for need of intense communication and its impact on the success of the project in distributed software development stimulated the research efforts for effective communication tools and models to alter the communicational challenges [2]. These efforts gave birth to usage of asynchronous communication medias (email) and later on synchronous communication tools (Telephones, instant messages, Video conferencing) to mitigate the communicational challenges to perform requirements negotiation [26].

According to the study in 2012, even though there are several advancements in the technology and many communication media to facilitate distributed requirements negotiations, still practitioners are experiencing many challenges to perform the requirements elicitation and requirements negotiations practices [6]. This might be because of few reasons such as unavailability of crucial information about the industrial practices, how industrial practitioners perform requirements negotiations in distributed environment or because of lacking the primary information regarding available tools to mitigate these requirements negotiation challenges.

Author Damian et al. conducted six research studies with six academic group of students in an academic experimental setup to illustrate the need for tools to facilitate requirements negotiations in distributed environment with clients and suppliers [22].

She claims that evaluation of web based multimedia tools were missing in distributive software development practices, and explained the necessity of face-to-face interaction before computer mediated communication [9]. She suggested the use of asynchronous communication before actual synchronous meetings through IBIS (Web based tool) for remote communication basing on her research results [10].

According to her study results [11] common understanding between the clients and suppliers can be achieved by using mixed media communication. Her comparative study to understand the effectiveness of text based communication over face-to-face interaction has shown positive results, which acted as the starting point for further research on computer mediated communication [6].
In another research study by Greenberg and Damain argued for distributive groupware environment to perform collaborative distributed activities [21]. However, after conducting several experimental studies she found that communication through face-to-face interactions are more satisfactory than other communication media to perform requirements negotiations in distributed software development.

In an experimental study conducted by Khan et al. with five student groups identified mix of synchronous and asynchronous communication media resolves conflicts more effectively [26]. Seyff et al. proposed system tool to support distributed requirements negotiation, Arena II and Arena M (Mobile). Evaluation of the tool was conducted with 10 delegates of 19th IEEE conference [33].

All these studies stated the importance of the communication media and tools to perform distributed requirements negotiation and conflict resolution tasks in industrial environment. However, there are no traces, that these studies are evaluated in industrial context which shows the necessity to know the industrial practices and utilization of tools. Since researcher’s claims there are still limitations in performing distributive requirements negotiations, this raises the question whether software industries are experiencing these limitations? It should be known in order to provide better solution.

2.3 Research Gap
In 2014 a tertiary study on Systematic studies in requirements engineering highlighted the two important areas requirements negotiations and conflict resolution which are ignored by the researches and not covered by any secondary studies and pointed the need for research on the particular area [3].

This research gap initiated to conduct secondary studies (Systematic Mapping Studies) on Industrial practices of requirements negotiation and conflict resolution in in distributed software development.

During the analysis of systematic mapping studies, from the article 2012 it is found that requirements negotiations activities are still experiencing the communicational challenges in spite of several advancements [6] and in an article from 2013 stated the need for the guidance in performing requirements negotiation activities due to many benefits [35]. This claims are supported by the section 2.1 Background, it observed that there are no significant studies stating any information about the industrial practices on the target research area. To my knowledge this study is considered as the first systematic study on the focus area. Filling this gap helps practitioners and researcher to know all readily available tools to perform negotiation tasks and this study can be considered as the primary source of information for industries before opting interventions to perform requirements negotiation.
3 Research methodology
In this section formulation of research questions, research plan, and research methods of the study are provided.

3.1 Research Questions
In this section, research questions are formulated and documented. Structuring of these questions are carried according to the objectives stated in the section 1.1.1.

RQ.1. What is the state of published research on the Requirements negotiations and Conflict resolution in distributed software development?
   a. What is the focus of the research on the Requirements negotiations and Conflict resolution in distributed software development?

RQ.2. What are the literature proposed interventions to perform Requirements negotiations in distributed software development?
   a. What are tools/models/practices proposed for Requirements negotiations in distributed software development?
   b. Are these proposed interventions validated in the industrial context?

RQ.3. What are the literature proposed interventions to perform Conflict Resolution in distributed software development?
   a. What are tools/models/activities proposed for Conflict Resolution in distributed software development?
   b. Are these proposed interventions validated in the industrial context?

The research questions RQ.1 is formulated to identify all the relevant primary studies on the focus area and RQ.2 and RQ.3 are formulated to identify literature proposed intervention for the requirements negotiations and conflict resolution in the in distributed software development. Systematic mapping study is considered to answer these research questions.

RQ.4. What is the current state of practice on the interventions used by the software practitioners to perform requirements negotiations in distributed software development?
   a. What are the preparatory activities used prior to actual negotiation meetings?
   b. What are the tools/models used to perform Requirements negotiations?
   c. To what extent does the experience of the clients and suppliers differ on Requirements negotiations tools/models/preparatory activities?

RQ.5. What is the current state of practice on the interventions used by software practitioners to perform Conflict Resolution in distributed software development?
   a. What are the preparatory activities used prior to actual negotiation meetings?
   b. What are the tools used to perform Conflict resolution?
   c. To what extent does the experience of the clients and suppliers differ on Conflict resolution tools/models/preparatory activities?

RQ.6. What are the factors affecting the Requirements Negotiations in distributed software development?
   a. To what extent does the agreement of the clients and suppliers differ on the factors affecting Requirements negotiations?

RQ.7. What are the factors affecting the Conflict Resolution in distributed software development?
   a. To what extent does the agreement of the clients and suppliers differ on factors affecting Conflict resolution?

Research questions RQ.4 and RQ.5 are formulated to get current usage of interventions by the industrial practitioners in distributed software development and individual agreement of the clients and suppliers are taken in to notice to analyze the variance in the agreement on interventions that are in use.
Research question RQ.6 and RQ.7 are formulated to understand the level of agreement of clients and suppliers towards the identified factors in the systematic mapping study, affecting requirements negotiation and conflict resolution in distributed software development.

Figure 1 provides a pictorial representation of the research plan, with outputs of each activities and each phase in the master thesis.

![Figure 1 shows the research plan of master thesis](image)

The end results of the systematic mapping study reflect the research questions RQ1 state of published research, RQ2 proposed interventions to perform requirements negotiations and RQ3 proposed interventions to perform conflict resolution in distributed software development as shown in the Figure 1.

Performing descriptive analysis on the collected survey data RQ4 current state of industrial practice on the interventions used by the software practitioners to perform requirements negotiations and RQ6 factors affecting the requirements negotiations in distributed software development

Similarly, RQ5 current state of industrial practice on the interventions used by software practitioners to perform conflict resolution and RQ7 factors affecting the conflict resolution in distributed software development were answered.
Here in the Table 1 mapping of the research questions with respective research method are shown.

<table>
<thead>
<tr>
<th>Research Questions</th>
<th>Research methods</th>
<th>Results in</th>
</tr>
</thead>
<tbody>
<tr>
<td>RQ1</td>
<td>Systematic mapping studies</td>
<td>State of published research on focus area</td>
</tr>
<tr>
<td>RQ 2</td>
<td>Analysis on Systematic mapping studies</td>
<td>Requirements negotiations in industrial practices</td>
</tr>
<tr>
<td>RQ3</td>
<td>Analysis on Systematic mapping studies</td>
<td>Requirements negotiations in industrial practices</td>
</tr>
<tr>
<td>RQ4 and RQ6</td>
<td>Descriptive analysis of survey</td>
<td>Current state of industrial practices to perform Requirements negotiations and factors affecting Requirements negotiations in distributed software development</td>
</tr>
<tr>
<td>RQ5 and RQ7</td>
<td>Descriptive analysis of survey</td>
<td>Current state of industrial practices to perform Conflict Resolution and factors affecting Conflict Resolution in distributed software development</td>
</tr>
</tbody>
</table>

Table 1 represents the mapping of research question with respective to the research method.

3.2 Systematic Mapping Study

Basing on the Section 2.3 it is evident that no secondary studies are available on this research area. Secondary studies are important, because of their ability to summarize and provide an overview of research topic which helps in knowing the maturity of research area, available number of reports, results on the research area and research coverage on the specific area [27], [30] and [31].

According to the study [27] these secondary studies aims to answer specific research question by reviewing, integrating and synthesizing the available primary studies to exhibit the existing research evidence on the specific topic. Systematic literature review and Systematic mapping study are the two existing secondary studies with well-defined methodologies, these methods follow defined process in order to reduce the bias of their conclusions [27]. These secondary studies are also known as systematic studies.

Systematic mapping study is considered as the secondary study for this master thesis due to its suitability to structure the research area by providing board overview, by identifying the studies, categorizing them into research types and by establishing the research evidence along with quantitative data of evidence on the research area. Often mapping these frequencies of publications over the time helps in observing research trend [27], [30] and [31]. However, Systematic literature reviews can be considered as the alternative for this study because of the commonalities in performing study searching and selection, but as said earlier the focus of this study is to structure the research area and to establish research evidence on the topic rather than synthesizing or considering the strength of evidence according the systematic literature studies [27], [30] and [31].

3.2.1. Overall Design

Review protocol: A review protocol is designed to conduct the Systematic Mapping studies, this is structured in procedural manner starting from formulations of search string, followed by database selection, data extraction, and data analysis.

Identification of literature: A literature review has chosen as search technique since there are no previous literature reviews on the focus area and also for its well-known ability to provide quality evidence.

Constructing search string: To formulate search string, keywords are to be identified and connected with the logical operators which is explained in below section.

Keywords: Keywords are identified using PICOC (Population, Intervention, Comparison and Outcomes, Context) suggested by Kitchenhamn [27] and from research questions.
Population: In software engineering experiments, the population can be an application area [27]. In this study Requirements Engineering with in Global software engineering, Global software development, and distributed software development were the areas of focus.

Intervention: The intervention can be software methodology, tools, technology or procedure to address specific issue [26]. In this is study we are trying to identify all the relevant interventions related to Requirements Negotiation and Conflict Resolution in the focused research area.

Outcomes: Outcomes of the studies should relate to the importance to the practitioners [27]. Author believe that the end results of this study can act as the primary source of information on requirements negotiations and conflict resolution to the practitioners.

Apart from the PICOC, keywords are identified from the research questions shown in Table 2.

<table>
<thead>
<tr>
<th>Population</th>
<th>Intervention</th>
<th>Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Requirements Engineering); (Global Software Engineering), (Global Software Development) and (Distributed Software development);</td>
<td>(Requirements); (Negotiation)</td>
<td>(Conflict); (Resolution)</td>
</tr>
</tbody>
</table>

Table 2 Keywords are identified clustered into sets based from PICOC

The next step is to identify the synonyms for the keywords and connecting them with the Boolean operators (Logical AND/ Logical OR) shown in Table 3.

<table>
<thead>
<tr>
<th>Formulation</th>
<th>Keywords</th>
<th>Connectors</th>
<th>Keywords</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Set 1)</td>
<td>(Requirements Engineering) AND (Global OR Distributed OR Geographical) AND (Negotiation OR agreement OR settlement))</td>
<td>AND</td>
<td>(Resolution OR Settlement OR Clarification OR Resolve)</td>
</tr>
<tr>
<td>(Set 2)</td>
<td>(Requirements) OR (Global OR Distributed OR Geographical)</td>
<td>AND</td>
<td>(Negotiation OR agreement OR settlement))</td>
</tr>
<tr>
<td>(Set 3)</td>
<td>(Conflict OR Disagreement OR Mismatch)</td>
<td>AND</td>
<td>(Resolution OR Settlement OR Clarification OR Resolve)</td>
</tr>
</tbody>
</table>

Keywords Set 1 is common for both Search Strings 1 AND 2.

<table>
<thead>
<tr>
<th>SEARCH STRING</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEARCH STRING 1 (Set 2 AND Set 1)</td>
<td>{((Requirements) AND (Global OR Distributed OR Geographical) AND (Negotiation OR agreement OR settlement)) AND ((Requirements Engineering) AND (Global Software Engineering OR Global Software Development OR Distributed Software Development OR Multi-Site Development OR Off-Shore Development OR Out Sourced Development)))</td>
</tr>
</tbody>
</table>
Table 3 explains the formulation of keywords and search string for database search, search strings are formulated in the combination of formulation set 2 with Set 1 and combination of formulation set3 with set1.

### 3.2.2. Selection of Databases

These keywords are to be applied to the bibliographic databases (INSPEC and SCOPUS) and article databases (IEEE Explore, Springer, and ACM). The reason for choosing the following databases where bibliographic databases have huge access of articles from several publishers and article databases has several proceedings of the research area. The search is performed on the following databases by looking primarily for the following key terms in Title, Abstract and keywords of the articles.

**Inclusion criteria**
- Inclusion of studies where their primary focus is on requirements negotiation or conflict resolution in requirements engineering within the context of Global or distributed environment, apart from co-located requirements negotiation or conflict resolution
- Inclusion of empirical studies, Experimental studies, Case studies and Comparative studies between the interventions.
- Inclusion of the articles those are peer reviewed (excluding keynotes, blogs).
- Articles only in English are considered for the study.

**Exclusion criteria**
- Exclusion of studies other than Software Engineering such as Civil and mechanical engineering, nuclear engineering computing, Product engineering computing, Object oriented programming and Medical sciences and computing.
- Excluding the duplicates articles
- Excluding the articles without full text.

### 3.2.3. Data Extraction

Data extraction form is carefully designed to the extract the information from the identified primary studies with relevance to research questions, this data is further used in designing empirical survey. The following Table 4 shows the systematic mapping studies extraction form.

<table>
<thead>
<tr>
<th>Article ID</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title of the article</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Author’s</td>
<td>Names of author’s</td>
<td></td>
</tr>
<tr>
<td>Year</td>
<td>Year of studies</td>
<td></td>
</tr>
<tr>
<td>Type of article</td>
<td>Journal, Conference proceeding</td>
<td></td>
</tr>
<tr>
<td>Publication</td>
<td>Name of publication</td>
<td></td>
</tr>
<tr>
<td>Primary focus</td>
<td>Requirements negotiation/ Conflict resolution</td>
<td></td>
</tr>
</tbody>
</table>
Proposed Intervention/Name

- Model: If the study tries design, develop or evaluate the model for mitigating the challenge in Requirements engineering fall under model.
- Process: If the study discusses or contribute the process in software Engineering.
- Approach: If the study tries to provide initial proposal about the challenges handling in software engineering.
- Framework: If the study tries to discuss or contributed a set of guidelines to accomplish task in Software engineering falls under this category.
- Tools: If the study creates, investigate and report the experience of the tool in Software engineering falls under this category.

Study Context
- Academic: If the study is conducted within the academic setup or environment, then it falls under academic study.
- Industrial: If the study is conducted within the Industrial setup or environment, then it falls under industrial study.
- Both: If the study uses the both setups, then it falls under both study contexts.
- Unclear: If the study uncears about the study context or unavailable information related study setup.
- Research type

- Evaluation research: If the study is trying to investigation of problem in RE practice that doesn’t exit.

Proposal of solution:
- If the study is proposing a solution and arguing for its relevance.

Validation study:
- If the study is trying to investigate the properties of solution proposed elsewhere by other author.

Philosophical paper:
- New way of looking things, new conceptual framework.

Table 4 Data extraction form

<table>
<thead>
<tr>
<th>Proposed intervention/Name</th>
<th>Ex. Models, process, approach, framework, and tools.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study context</td>
<td>Academic</td>
</tr>
<tr>
<td>Research method</td>
<td>Empirical study</td>
</tr>
<tr>
<td>Research type</td>
<td>Solution proposal</td>
</tr>
<tr>
<td>Target audience</td>
<td>Researchers</td>
</tr>
<tr>
<td>Type of Subject involved</td>
<td>Academic Students</td>
</tr>
</tbody>
</table>

Data fields such as Study context, Research type, Target audience and Type of Subjects involved in the data extraction form are used to know the rigor and relevance of the selected studies.

The Proposed intervention, Study context, and research type is adopted from to the mapping studies [34], which is further explained in the following section.
Opinion paper:
- If the study is stressing of need of intervention or to mitigate challenges.

Personal experience:
- Experience of the researcher for particular period of time in the study environment

Explorative:
- If the problem is unclear explorative research type is used.

These following research types are adopted from the study [34], [36]and [41].

3.2.4. Execution of Systematic Mapping Studies

The execution of literature review which is designed in the 3.2.1 is presented in this section. This phase starts with the selection of primary studies and ends with extracting the data from studies.

The review protocol was executed systematically according to the design described in the section 3.2. In order to obtain primary studies, search string was applied on the databases. A basic inclusion and exclusion criterion was applied on these search results which provided primary studies. These primary studies were checked for duplicates by using Microsoft excel after removing duplicates these primary studies were considered for full text reading and irrelevant articles were removed. Table 5 represents the strings used for database search.

<table>
<thead>
<tr>
<th>Database</th>
<th>Requirements Negotiation Search String</th>
<th>Conflict resolution search String</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scopus</td>
<td>TITLE-ABS-KEY (requirements) AND TITLE-ABS (global) OR TITLE-ABS (distributed) OR TITLE-ABS (geographical) AND TITLE-ABS-KEY (negotiation) OR TITLE-ABS-KEY (agreement) OR TITLE-ABS-KEY (settlement) AND TITLE-ABS-KEY (requirements engineering) AND TITLE-ABS-KEY (global software engineering) OR TITLE-ABS-KEY (distributed software development) OR TITLE-ABS-KEY (global software development) OR TITLE-ABS (off-shore) OR TITLE-ABS (out sourced)</td>
<td>TITLE-ABS-KEY (Conflict) OR TITLE-ABS (Disagreement) OR TITLE-ABS (Mismatch) AND TITLE-ABS-KEY (Resolution) OR TITLE-ABS-KEY (settlement) OR TITLE-ABS (clarification) OR TITLE-ABS (resolve) AND TITLE-ABS-KEY (requirements engineering) AND TITLE-ABS-KEY (global software engineering) OR TITLE-ABS-KEY (distributed software development) OR TITLE-ABS (multi-site) OR TITLE-ABS (off-shore) OR TITLE-ABS (out sourced)</td>
</tr>
<tr>
<td>Inspec</td>
<td>((((((global) WN KY) OR ((distributed) WN KY)) OR ((geographical) WN KY)) AND ((requirements) WN KY)) AND (((negotiation) WN KY)) OR ((agreement) WN KY)) OR ((settlement) WN KY)) AND ((requirements engineering) WN KY)) AND (((global software engineering) WN KY)) OR ((global software development) WN KY)) OR ((distributed software development) WN KY)) OR ((multi-site) WN KY)) OR ((offshore) WN KY)) OR ((out sourced) WN KY))</td>
<td>((((((conflict)WNKY) OR ((disagreement)WNKY)) OR ((mismatch)WNKY)) AND (((resolution)WN KY) OR ((settlement) WN KY)) OR ((clarification) WN KY)) OR ((resolve) WN KY)) AND (((requirements engineering) WN KY)) AND (((global software engineering) WN KY)) OR ((global software development) WN KY)) OR ((distributed software development) WN KY)) OR ((multi-site) WN KY)) OR ((offshore) WN KY)) OR ((out sourced) WN KY))</td>
</tr>
<tr>
<td>IEEE</td>
<td>Requirements Negotiation AND Requirements Engineering</td>
<td>Conflict resolution and requirements engineering</td>
</tr>
</tbody>
</table>
String based searches are performed on Scopus and Inspec bibliographic database, keyword based search are performed on IEEE, Springer and ACM databases to ensure the coverage and to avoid the missing of any relevant articles from search. From table 6 it is seen that no new articles are found in ACM and springer database. Removing duplicates and applying initial inclusion criteria ended with 20 relevant studies and data is been extracted from those 20 primary studies.

3.2.5. Quality Assessment
Quality assessment criterion is conducted for the final set of papers obtained after the completion of database search procedure. Rigor and relevance assessment is applied on the final set of the articles to assess the trustworthiness. The assessment is accordance to the checklist provided by Ivarsson et.al [25].

3.2.6. Validity threats of Systematic Mapping Studies
In this section, the potential validity threats of systematic mapping studies and the mitigation strategies are discussed.

Construct validity: construct validity threats in mapping studies are caused by excluding the relevant primary studies [38]. To ensure the inclusion of the relevant studies as many possible, proper care has been taken while choosing the keywords, several iterations of keywords and searches are performed on the databases. Additional keywords are also included to the search string to identify the articles, these additional keywords are obtained from the relevant articles and conference publication on the topic area, this strategy increased the effort and time for database search. Scopus, IEEE, Inspec, ACM and Springer databases are considered as the suitable database due to its prominence in the requirements engineering topics.

Internal validity: Internal validity deals with extraction and data analysis [29, 13]. The author carried out the data extraction from the final set of the articles, by using the data extraction forms that are designed for this study by following guidelines of Kichenham [27], these extraction results are thoroughly checked by mapping the results with research questions [36].

Conclusion validity: Conclusion validity can be a threat in systematic mapping studies which is concerned with identification of incorrect relationships that leads to incorrect conclusions. In this thesis a review protocol is developed prior to the actual data extraction and mapped the expected outcomes with the research questions. Traceability of every activity and steps performed during the data extraction and drawing conclusions in the thesis strengthens the strategy and tries to mitigate the threat.

External validity: External validity is concerned with generalizing the results to different groups and different settings. In this systematic mapping studies results are considered to regard with distributed software development and no time limit is introduced in the search of published studies so the selected studies are not affected by the presentation. The articles chosen had high rigor value, which can be a sign of more relevant to the industrial context.

3.3 Industrial Survey
Industrial survey is conducted by using the collected data from the systematic mapping study about the interventions (communicational tools, models, communication media’s) to perform requirements negotiation and conflict resolution in distributed software development. The intention of this survey to validate the identified interventions from the literature and to bring out the industrial practitioner’s insight about the both requirements negotiation and conflict resolution activities, which is considered as the novelty of this study. This survey is also intended to gain knowledge about the aspects that were not covered in the literature such as factors affecting the requirements negotiation and conflict resolution activities in distributed software development.
3.3.1. Motivation for choosing survey as research methodology
The empirical survey is considered as the best suitable research method for this study, due to its ability to quantify and summarize the results from the large population. Since this study is targeted to identify the industrial insights of performing requirements negotiations and conflict resolution [16].

Interview was regarded as a good alternative, however it is not possible to generalize or quantify the widely used studies basing on few interview and conducting several interview in many companies requires time and industrial contacts. Malhotra et al. specified that survey can be conducted in different types of approaches such as phone survey, personal survey, mail and electronic survey [29]. Mail and electronic media survey were used in this research. The main reason for selecting an electronic survey is to gather the responses on a larger scale of respondents and participants who works in different organization around the different parts of the globe. Electronic survey allows participations of respondents in large number and considerably take less time to design and publish, eases the handling and analyzing the collected data. Google sheets are used to prepare online questionnaire, it has user friendly interface and provides the ability to analyze of data.

3.3.2. Overall Design
In this phase planning of survey, designing the survey and executing survey are defined.

Planning of the survey
Planning of the survey starts with identifying the objective, the primary reason for identifying the objectives are to identify the scope of survey, to know the sample type of respondents to obtain valid information. These objectives of survey are obtained on the basis of research question of this study.
- To validate the identified interventions of requirements negotiation and conflict resolution in distributed software development and to know to what extent they provide effective support.
- To identify any additional intervention that are used by the industrial practitioners to perform the negotiation and conflict resolution activities.
- To identify the factors that affects requirements negotiation and conflict resolution in distributed software development.

Scheduling the survey
The survey was scheduled for four week of time, basing on the primary proposal of study and overall time plan of the study.

Planning the Resources
Online survey approach is considered for this study, since accessing and participating in the survey is easier compared other approaches and requires less effort to handle the collected data. Survey questionnaire is sent to all requirements engineering practitioners who has hands on experience in performing requirements negotiation and conflict resolution in distributed software engineering. The information regarding the respondents job role and previous experience is collected from the LinkedIn, Facebook and google professional groups. Survey questionnaire is sent to the respondents through personal email, Facebook and LinkedIn.

Designing of Survey
The questionnaire of this survey is designed in a way to collect the responses of the respondent basing on the active role (client or supplier). This survey questionnaire consists of close ended and open ended questions [32].

In total, the questionnaire consists of 14 questions (see Appendix A) and divided into three parts. First part of this questionnaire consists of five questions related to demographics that includes active role, current work experience related to requirements negotiations and conflict resolution in distributed software development. The second part of the questionnaire aimed to capture the data regarding the requirements negotiations interventions and affecting factors in distributed software development the respondents were asked to provide their agreement by using the Likert scale with a 6 scale of (Completely agree –completely disagree), A data field is provided to the respondents to acquire additional information regarding the industrial insights. The third part of the questionnaire captures the conflict
resolution activities and affecting factors. Similar Likert scales is used to collect the data from respondent. As a last step, respondents were presented a text box with a question to give their email address to receive the results of the survey. The survey questionnaire is provided in the Appendix A.

**Questionnaire Validation**

The questionnaire must be validated prior to actual collection of data, this validation helps to ensure readability, understandability and to calculate the time that required to answer entire questionnaire. According to Kitchenham et al. [28] survey should check understandability, response rate, reliability and validity to meet the expected responses. Pilot study has been conducted with the 10 respondents who has prior knowledge related to the distributed software development. Two active researchers are involved in the second iteration of survey pilot study and few improvement related understandability and context are made. Initially the questionnaire has 18 questions in total and took 10 minutes of time to answer but few respondents felt questionnaire is too long and researchers suggested to cluster the tools into one clusters to reduce the length of questionnaire after improvement these 18 questions are reduced to 14 question and took 7 minutes of time to answer entire the questionnaire. After the improvements respondents felt the questionnaire was more easy to understand and takes less time to answer it. Therefore, the final questionnaire was selected for the survey and it is provided in the appendix A.

**Likert Scale**

Likert scale is considered for this study to access the agreement levels of the respondent for given questions. Likert scale is very common in survey research, in general Likert scale has five to nine scale rating levels to measure attitude of the respondents ranging from completely agree to completely disagree [39]. In this study five and six scale rating level are used depending on the question to capture the respondent’s agreement levels.

**Survey Analysis**

Descriptive Statistical method is used to analyze the survey data collected in this study, these descriptive statistical method is utilized to analyze and summarize the respondent data and present them in the form of numbers and graphs [40].

3.3.3. **Validity threats for Survey**

The reliability and the exactness of the research are influenced by few factors regardless of how well the research is executed. For this research the author has come across following validity threats in relation with survey and they are internal, external, construct validity as discussed by Wohlin et al. [40].

**Internal validity:** Internal validity is the threat associated with the questionnaire and is the kind of questions listed in the survey. This kind of threat may happen when the respondent does not prefer to answer any specific question of the survey as they may not observe it or they could not feel to answer it. Thus to mitigate this threat, the survey was designed within the simplest possible way. An option, “Did not use it” was included for each of the question just in case the respondents does not prefer to select the answer needed. In addition, personal data of the respondents wasn't requested and an open ended question was asked to answer for the interested respondents to mention their email to get the results of the survey. In addition, few of the responses which are found to be inconsistent are being answered by considering the responses obtained from experienced persons as well as the perception given by the respondents under open ended question.

**Low response rate for survey:** The amount of responses that were obtained in the survey was another threat, which made us difficult in making generalizable statement regarding the information obtained through the survey. The author has made an attempt to obtain as many responses as possible. Due to time constraints it was difficult to have an outsized range of responses. At last we were successful in getting 41 responses. Classifying the respondent into clients and suppliers raised problem while comparing the prospective of both respondents, additional statistical analysis is not permitted because of unbalanced sample sizes of clients and suppliers.
**Construct validity:** Construct validity occurs when the questionnaire is more abstract and contains irrelevant questions to the research topic. To mitigate this threat questionnaire of this study was developed on the results of systematic mapping studies on requirements engineering and conflict resolution in distributed software development. Questionnaire was reviewed during pilot test to ensure the readability and understandability of the practitioners.

4 Results

4.1 Results and Analysis of Systematic Mapping Studies

Table 6 shows the database results and final set articles that are selected for this study. In this table RN represents requirements negotiation and CR represents Conflict resolution.

<table>
<thead>
<tr>
<th>Database</th>
<th>Total hits</th>
<th>Considered for final studies</th>
<th>Duplicates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RN</td>
<td>CR</td>
<td>RN</td>
</tr>
<tr>
<td>Scopus</td>
<td>52</td>
<td>13</td>
<td>11</td>
</tr>
<tr>
<td>Inspec</td>
<td>31</td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td>IEEE</td>
<td>38</td>
<td>413</td>
<td>5</td>
</tr>
<tr>
<td>ACM</td>
<td>55</td>
<td>155</td>
<td>-</td>
</tr>
<tr>
<td>Springer</td>
<td>975</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Table 6 represents Database search*

Systematic mapping study successfully identified 20 relevant article from the all the database searches and literature review is conducted on the following articles. Table 7 represents the identified articles for the final systematic mapping study. Table 7 shows the Study identification number, Title of the article and Names of the author.

<table>
<thead>
<tr>
<th>Study ID</th>
<th>Title</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>S2[7]</td>
<td>Asynchronous requirements engineering: Enhancing distributed software development</td>
<td>Catherine Lowry Campbell and Bartel Vande Walle</td>
</tr>
<tr>
<td>S3[11]</td>
<td>The role of asynchronous discussions in increasing the effectiveness of remote synchronous requirements negotiations</td>
<td>Daniela E. Damian, Filippo Lanubile, Teresa Mallardo</td>
</tr>
<tr>
<td>S4[10]</td>
<td>On the need for mixed media in distributed requirements negotiations</td>
<td>Daniela E. Damian; Lanubile, F; Mallardo, T</td>
</tr>
<tr>
<td>S5[6]</td>
<td>Computer-mediated communication to support distributed requirements elicitations and negotiations tasks</td>
<td>Calefato, Fabio; Daniela E. Damian; Lanubile, Filippo</td>
</tr>
<tr>
<td>S6[9]</td>
<td>An empirical study of the impact of asynchronous discussions on remote synchronous requirements meetings</td>
<td>Daniela E. Damian, Filippo Lanubile and Teresa Mallardo</td>
</tr>
<tr>
<td>S7[18]</td>
<td>Synchronous communication media in the software requirements negotiation process</td>
<td>Ugo Erra and Giuseppe Scanniello</td>
</tr>
<tr>
<td>S8[21]</td>
<td>Using a groupware space for distributed requirements engineering</td>
<td>Daniela Herlea and Saul Greenberg</td>
</tr>
<tr>
<td>S9[33]</td>
<td>Enhancing GSS-based requirements negotiation with distributed and mobile tools</td>
<td>Norbert Seyff, Christoph Hoyer, Erich Kroiher and Paul Grünbacher</td>
</tr>
<tr>
<td>S10[26]</td>
<td>Impact of changing communication media on conflict resolution in distributed software development projects</td>
<td>Huma Hayat Khan, Nauman Malik, Muhammad Usman and Naveed Ikram</td>
</tr>
</tbody>
</table>
Table 7 shows the final articles selected for the study

<table>
<thead>
<tr>
<th>Study</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>S11[5]</td>
<td>An empirical investigation on text-based communication in distributed requirements workshops</td>
<td>Fabio Calefato, Daniela E. Damian and Filippo Lanubile</td>
</tr>
<tr>
<td>S13[14]</td>
<td>The impact of stakeholders' geographical distribution on managing requirements in a multi-site organization</td>
<td>Daniela E. Damian and Didar Zowghi</td>
</tr>
<tr>
<td>S14[12]</td>
<td>An exploratory study of facilitation in distributed requirements engineering</td>
<td>Daniela E. Damian, Armin Eberlein Mildred L. G. Shaw and Brian R. Gaines</td>
</tr>
<tr>
<td>S15[13]</td>
<td>An insight into the interplay between culture, conflict and distance in globally distributed requirements negotiations</td>
<td>Daniela E. Damian and Didar Zowghi</td>
</tr>
<tr>
<td>S16[35]</td>
<td>Requirements negotiation model: A social oriented approach for software ecosystems evolution</td>
<td>George Valença</td>
</tr>
<tr>
<td>S18[1]</td>
<td>An empirical assessment of the use of different communication modes for requirement elicitation and negotiation using students as a subject</td>
<td>Ahmad, R, Tahir, A.; and Kasirun, Z.M.</td>
</tr>
</tbody>
</table>

4.1.1. Primary focus of the identified studies.
The primary focus of the identified primary studies shown by Figure 2

Figure 2 represents the primary focus of the extracted studies. In the form of pie chart, out of the total 20 extracted studies 16 studies are focusing on Requirements Negotiation, 1 study is on conflict resolution and 3 studies are focusing on the both Requirements Negotiation and Conflict Resolution.

4.1.2. Frequency of the articles published on research topic
Figure 3 shows the frequency of the articles published on the focus area in several years in graphical representation. This data is appended from literature studies extraction form.
4.1.3. Identified studies by article types
Following Figure 4 shows the article types of extracted studies. This data is taken from the extraction form of the systematic studies to answer research question RQ1.

![Figure 3 shows frequency of articles](image)

![Figure 4 shows article type of selected studies](image)

4.2 Analysis of Systematic Mapping Studies
In this section analysis of the primary studies is carried out regarding the interventions used for requirements in distributed software development.

Most of the studies identified from the literature review focused on communication aspects. The following data is extracted from the identified studies, this provides both interventions (communication tools for requirements negotiations) and recommendations for practitioners.

4.2.1. Requirements Negotiation (RN) in Distributed Software Development
Seven studies [S3, S6, S8, S9, S12, S14 and S20] proposed interventions to perform requirements negotiation activities in distributed software development and eleven studies [S1, S2, S4, S5, S7, S11, S13, S15, S18, S19 and S20] made their recommendations and conclusion on the use of communicational interventions to perform requirements negotiations.

Table 8 shows the interventions that supports requirements negotiations.

<table>
<thead>
<tr>
<th>Study ID</th>
<th>Proposed intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>S3</td>
<td>Use of IBIS web based tool for asynchronous interactions to perform requirements negotiation activities in distributed environment.</td>
</tr>
<tr>
<td>S6</td>
<td>Use of asynchronous tools (Email) for effective requirements negotiations</td>
</tr>
<tr>
<td>S8</td>
<td>Use of TeamWave (Teledata + TelePresence) for effective requirements negotiations</td>
</tr>
<tr>
<td>S9</td>
<td>Arena II and Arena Mobile models for requirements negotiation in distributed environment.</td>
</tr>
<tr>
<td>S12, S14, S20</td>
<td>Use of Microsoft NetMeeting for video conferencing tool, which is considered to be replacement to the face to face meetings.</td>
</tr>
</tbody>
</table>

*Table 8 Proposed intervention of Requirements Negotiations*
Table 9 provides the recommendations and conclusions for requirements negotiation studies in distributed software development.

<table>
<thead>
<tr>
<th>Study ID</th>
<th>Recommendations and conclusions</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>Use of video conferencing tool for effective requirements negotiations</td>
</tr>
<tr>
<td>S2</td>
<td>Use of discussions in asynchronous and distributed environment</td>
</tr>
<tr>
<td>S4</td>
<td>Use of Asynchronous communication for effective communication and to have common ground.</td>
</tr>
<tr>
<td>S5</td>
<td>Text-based elicitation offer support to achieving common ground</td>
</tr>
<tr>
<td>S7</td>
<td>Use of Face to face communication takes less time in requirements negotiations.</td>
</tr>
<tr>
<td>S11</td>
<td>Face to Face communication is preferred over computer mediated communication</td>
</tr>
<tr>
<td>S13</td>
<td>Distance and culture aspects affects requirements negotiations.</td>
</tr>
<tr>
<td>S15</td>
<td>Cultural differences, geographical distances are to be considered.</td>
</tr>
<tr>
<td>S18</td>
<td>Face to face is more preferred than text based and rich media</td>
</tr>
<tr>
<td>S16</td>
<td>The quality of communication channels for effective communication and understanding in DSD.</td>
</tr>
<tr>
<td>S19</td>
<td>Face to face is no better than video conferencing tool</td>
</tr>
<tr>
<td>S20</td>
<td>Face to face meetings before video conference helps in establishing interpersonal relation.</td>
</tr>
</tbody>
</table>

Table 9 Recommendation and conclusion of Requirements Negotiation

4.2.2. Conflict Resolution (CR) in Distributed Software Development

From the identified articles only three studies are focusing on conflict resolution in distributed software development. Among these studies, two studies have both requirements negotiation and conflict resolution as research focus and one study exclusively focused on the conflict resolution.

The following Table 10 provides the interventions and recommendation of conflict resolution in distributed environment.

<table>
<thead>
<tr>
<th>Study ID</th>
<th>Intervention / Conclusion</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>Use of video communication tool better than face to face meetings</td>
<td>Initial face to face meetings before video conferencing is important.</td>
</tr>
<tr>
<td>S3</td>
<td>On use of discussions and asynchronous meeting in distributed environment.</td>
<td></td>
</tr>
<tr>
<td>S10</td>
<td>Telephone-IM-Email, is the one which has resolved the ambiguity</td>
<td>Asynchronous communication before synchronous meetings are justified.</td>
</tr>
</tbody>
</table>

Table 10 Interventions and recommendation of Conflict Resolution

Table 11 depicts the Primary studies types, research methods and research type

<table>
<thead>
<tr>
<th>Study ID</th>
<th>Year</th>
<th>Article type</th>
<th>Research method</th>
<th>Research type</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>2001</td>
<td>Conference Proceeding</td>
<td>Experimental study</td>
<td>Explorative</td>
</tr>
<tr>
<td>S2</td>
<td>2003</td>
<td>Conference Proceeding</td>
<td>NA</td>
<td>Personal Experience</td>
</tr>
<tr>
<td>S3</td>
<td>2006</td>
<td>Conference Proceeding</td>
<td>Case study</td>
<td>Evaluation</td>
</tr>
<tr>
<td>S4</td>
<td>2008</td>
<td>Journal article</td>
<td>Case study</td>
<td>Evaluation</td>
</tr>
<tr>
<td></td>
<td></td>
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<tr>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>S5</strong></td>
<td>2012</td>
<td>Journal article</td>
<td>Experimental study</td>
<td>Validation</td>
</tr>
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<td>Experimental study</td>
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<td>Evaluation</td>
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<td>Evaluation</td>
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<tr>
<td><strong>S16</strong></td>
<td>2013</td>
<td>Conference Proceeding</td>
<td>Case study</td>
<td>Validation</td>
</tr>
<tr>
<td><strong>S17</strong></td>
<td>2010</td>
<td>Journal article</td>
<td>Experimental study</td>
<td>Evaluation</td>
</tr>
</tbody>
</table>
4.3 Analysis of systematic mapping study

Face to Face (co-located) communication and Computer mediated communication

According to the study by Erra et al. [S17] time taken to requirements negotiations are influenced by communication medium and in another study by author Valença [S16] found that effectiveness of requirements communication and understanding depends upon the richness of the communication channel.

From these two research findings it is clear that communication medium has vital role in requirements negotiations activities, however analyzing literature review results found few dissimilarities in research finding regarding to Face-to-face (co-located) communication and Computer mediated communication.

In an experimental study conducted in the year 2000 by author Damain [S12] with student groups and found that effectiveness of groups in face-to-face meetings are not better than the groups using video conferencing tools for requirements negotiations activities in distributed software development. Following in the year 2001 same author conducted two studies [S1] comparative study on traditional face-to-face meetings with multimedia meetings and found multimedia meetings are more effective than face-to-face meetings, and study [S20] and stated that face to face communication is not better than the communication through video conferencing tools.

Supporting this research finding an experimental study conducted by Calefato et. al [S11] in the year 2007 found computer mediated communication increases the clients and supplier’s participation opportunity compared to face to face communication in requirements negotiations activities.

However, in the year 2009 an experimental study by authors Ugo Erra and Giuseppe Scanniello found requirements negotiations through face to face meetings are resolved in less time compared to computer mediated communication supporting this statement another experimental study by Ahmad, R et. al [S18] found that face to face communication is most preferred among the participants and has highest level of satisfaction in performing requirements negotiation activities.

Preparatory activities

According to the experimental studies conducted by Damain et. al [S6], [S19] and [S20] stated the importance of initial face to face contact before actual computer mediated meetings which is part of preparative activities, having Face to Face meetings prior to actual video conferencing helps in establishing interpersonal relationship between the participants and recommended the use of structured asynchronous meetings before actual synchronous communication to reduce the cost and to improve effectiveness of the synchronous meetings. In a study [S3] recommended the use of IBIS tool web based tool for asynchronous interactions to perform requirements negotiation activities in distributed environment.

Tools to perform requirements negotiations and conflict resolution

Literature proposed synchronous and asynchronous tools to perform requirements negotiation and conflict resolution in distributed software development which are shown in the Table 8 and Table 10.

According to the studies by Damian et. al [S12], [S14] and [S20] proposed synchronous communicational tool such as video conferencing tool (Net meeting) for requirements negotiations, in a study by Greenberg et.al [S8] propose the use of groupware space (Tele data + Tele presence) for effective requirements negotiations.
Similarly, Khan et al. [S10] proposed use of Telephone, Instant messenger to solve ambiguity during conflict resolution in distributed software development.

On the other hand, asynchronous tools are recommended to perform requirements negotiations, in personal experience of Campbell et al. [S2] stated the use of asynchronous communication medium is increasing beneficial to expressing during the requirements negotiations supporting these statement author Calefato et al. [S5] found Text based communication is rated higher than face to face in distributed requirements negotiations in his experimental study.

According to the experimental study by Damian et. al [S4] rectifying the issues with asynchronous communication is proven effective than synchronous communication, this communication also helps in establishing the common ground between the clients and suppliers and asynchronous discussions provides support for the resolution of requirements. Among the asynchronous tools email is being dominant due to time zone differences between the distributed clients and suppliers according to the study by Zowghi et.al[S13]. Similar to these results, findings of the study[S3] shown email as the best suit for the coverage of information during the project planning and use of IBIS tool web based tool for asynchronous interactions to perform requirements negotiation activities in distributed software development.

Models to perform requirements negotiations and conflict resolution

Literature has shown two negotiations models Arena II and Arena M models for effective requirements negotiations in distributed environment which are proposed by Seyff et. al [S9].

Challenges to perform requirements negotiations and conflict resolution

There are few challenges listed in the literature to perform requirements negotiations and conflict resolution in distributed software development, According to author Damian et. al [S3] professional background and cultural aspects across the sites can be challenging, Cultural differences, geographical distances are to be considered as challenges according to the study[S15]. From the personal experience of Catherine Lowry Campbell and Bartel Vande Walle [S2] stated ineffective knowledge management, cultural diversity and time differences can be a challenging in distributed software development.

4.4 Discussion on systematic mapping study

In total 20 studies were identified after conducting the systematic mapping study. Based on the research questions, this research focus is divided in two parts. Firstly, identification of state of published research on Requirements negotiations and Conflict resolution in distributed software development such as trend of research and primary focus of the research, according to the tertiary study on Systematic studies in requirements engineering there are no secondary studies are available on the focused area [3].

From the literature review it is evident that researchers are concerned about communicational challenges in requirements negotiations and conflict resolution practices in the distributed software development, since all the studies in this research reported communication is being challenging activity.

Frequency of articles: according to the figure 3, 20 studies are identified on the research area since 1998 to 2013 expect the years 1999 and 2004. On an average 1 article per year is published and maximum of 3 articles published in the year 2003. Research frequency shows the existence of the following challenge in present time span and previous contribution on the research area with respective to the time(years).

Primary focus: the primary focus of the research is more emphasized on requirements negotiations rather than conflict resolution as shown in the figure1. However, these results can be depicted in two ways, assuming requirements negotiations are being more problematic practices to the industrial practitioners than conflict resolution practices or lack of the research attention towards conflict resolution in distributed software development.

Article type: Out of twenty studies 15studies are conference proceedings and five studies are journal article which shows the available research type on the focus area.

Secondly, this study is also focused on identification of the literature proposed interventions (tools/ models/ practices) to perform requirements negotiations and conflict resolution in distributed software development. Table 7 shows the
literature proposed interventions to perform requirements negotiations activities in distributed software development similarly Table 9 shows the literature proposed interventions to perform conflict resolution activities in distributed software development. Communicational tools such Video conferencing tools (Net meeting) [S12], [S14] and [S20], Asynchronous email[S6], IBIS tool [S3] and mixed media communicational tools such as TeamWave [S8] and Models like Arena II and Arena M [S9] are proposed to perform requirements negotiations activities. Similarly, Asynchronous discussions through IBIS tool [S3] and mixed media communication such as Telephone-IM-Email [S10]and video conferencing tools [S1] are proposed by literature to perform conflict resolution activities in distributed environment.

4.4.1. Quality Assessment

Rigor and Relevance of the study

<table>
<thead>
<tr>
<th>Study ID</th>
<th>Rigor Context</th>
<th>Study Design</th>
<th>Validity</th>
<th>Rigor sum</th>
<th>Relevance Context</th>
<th>Scale</th>
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<td>0.5</td>
<td>2.5</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

Table 12 Rigor and Relevance scores of the selected studies study

Rigor and relevance of the articles are calculated according to the study by Ivarsson et al [25]

Rigor of selected articles

Context

Strong description (1): If the context if the study is defined well so that reader can understand and relate it to another context.

Medium description (0.5): If the context of the study is defined in brief but not described enough well to understand and relate it another context.

Weak description (0): If the context of the study is not defined.

Study design

Strong description (1): If the study design is defined well so that reader can understand

Medium description (0.5): If the study design is briefly described.

Weak description (0): If the study design not defined.

Validity discussed
Strong description (1): If the validity threats of the study is defined in detail.
Medium description (0.5): If the validity of study defined but not defined.
Weak description (0): If there is no description on validity threats.

Relevance of the selected articles
Subjects
Contribute to relevance (1): If the subjects used in the study are intended user of technology.
Do not contribute to relevance (0): If the subjects used in the study are students, researchers, and subjects not mentioned.
Context:
Contribute to relevance (1): If the context of the study setting is representative of intended usage
Do not contribute to relevance (0): If the study performed in laboratory or academic setting
Scale
Contribute to relevance (1): If the scale of application has realistic or industrial scale
Do not contribute to relevance (0): If the scale of application has unrealistic scale
Research method
Contribute to relevance (1): Action research, Lessons learned, Case study, field study, Interview, descriptive or explorative.
Do not contribute to relevance (0): Conceptual analysis, Conceptual analysis/mathematical, Laboratory experiment (human subject) Laboratory experiment (human subject), Other and N/A.

From the Table 12 is observed that selected articles have high rigor and low relevance, this is because of the subjects involved in the most selected studies (mostly students), study context (academic settings) and research method used in the study.

4.5 Survey Results
This survey is carried out by using Google Forms an online survey tool. In the current section, findings from survey demographics and involvement with Requirements negotiations and Conflict resolution in distributed software development (DSD) is pointed and analyzed. Altogether 100 invitations were sent out, respondents are selected by looking at their work experience in Distributed environment from their LinkedIn profiles, Google groups and various other discussion groups. Questionnaire are sent to those responders by Facebook and email. A total of 45 responses are received, among them 41 completely responses are considered for this study and 4 incomplete responses are removed, due to the fact respondents never performed requirements negotiation or conflict resolution activities in distributed environment. Hence, a total 45% of response rate, 92% completeness rate and 8% of incomplete responses are achieved by this survey.

4.5.1 Demographics
Analysis of Respondents Information
Several demographic questions are asked to the respondents to know their familiarity with the Requirements Negotiations and Conflict Resolution activities in distributed software development. These demographic questions helped to understand the context and background of the respondents and assured the real time hands on experience with the both Requirements negotiation and conflict resolution concepts.

The entire survey was carried in the fashion by splitting the respondents into two categories basing on their active role i.e. either as clients or as suppliers. This differentiation is made to know the variance in the agreement of clients and suppliers towards the identified interventions.

Figure 5 shows the statistics of the respondents that took part in the industrial survey. A total of 41 respondents participated and among them 31(76%) participants were suppliers and 10 (24%) were clients.
Respondents participation in the Industrial Survey

**Respondents Countries**

Respondents from 6 continents and from 15 different countries took part in the Industrial Survey, among the results from the countries India has highest number of responses 17 with percentage of 41.46%. And when the response rate calculated on the basis of continents, Asia has highest response rate with 61.36%. This shows the respondents from different countries are participated in the Industrial survey, since the research area had relevance with the different geographical regions. Table 13 shows the response from different counties along with the frequency rate.

<table>
<thead>
<tr>
<th>Continent</th>
<th>Countries</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Europe</td>
<td>Germany (1), Poland (1), United Kingdom (3)</td>
<td>5 (11.36%)</td>
</tr>
<tr>
<td>Asia</td>
<td>China (3), Pakistan (2), India (17), Bangladesh (2), UAE (1), Indonesia (1)</td>
<td>27(61.36%)</td>
</tr>
<tr>
<td>Australia</td>
<td>Australia (3)</td>
<td>3(6.81%)</td>
</tr>
<tr>
<td>North America</td>
<td>USA (3), Canada (1), Mexico (1)</td>
<td>5(11.36%)</td>
</tr>
<tr>
<td>South America</td>
<td>Brazil (3)</td>
<td>3(6.81%)</td>
</tr>
<tr>
<td>Oceania</td>
<td>New Zealand (1)</td>
<td>1(2.27%)</td>
</tr>
</tbody>
</table>

*Table 13 represents the respondent’s countries and frequency rate.*

**Respondents Job roles**

Figure 6 represents the respondents’ job roles, along with the corresponding percentages. These results suggest that respondents from different roles participated in the Requirements negotiation and conflict resolution activities in the distributed software development environments.

- **Managerial roles:** Managerial roles constitute 44% of the total respondents and include project managers, Project leads, Project engineers, senior software engineer and technology leads.
- **Non-Managerial roles:** Non managerial roles constitute around 56% of the total respondents and include Software developers, Requirement testers, Application developer, Requirements analyst and Business analyst and Designers.
Figure 6 represents the roles and response rate along with the percentages.

![Job Roles Pie Chart]

*Figure 6 shows the different roles of the respondents participated in the survey with percentages.*

**Work Experience of Respondents**

Figure 7 represents the experiences of the respondents with Requirements Negotiations (RN) and Conflict Resolution (CR) activities in the distributed software development with frequencies and percentages.

From the results 56% respondents have more than 3 years of experience in distributed software development, 36.59% of the respondents have two years of experience, while only 7.32% have 1-year experience in performing the requirements negotiation and conflict resolution in distributed software development. These experiences indicate that the received responses are based on actual experience on the research topics.

![Respondents work expirence with RN and CR Pie Chart]

*Figure 7 shows the respondents current work experience values (%).*
Respondents performs both Requirements Negotiations and Conflict Resolution.

In this survey, there are few respondents either performed only requirements negotiations or conflict resolution. From the survey results it is observed that 89% respondents performed both the requirements negotiations and conflict resolution activities in distributed software development and 11% of respondents performed only one activity either requirements negotiation or conflict resolution, which is represented in the Figure 8.

![Figure 8 shows respondents perform both Requirements Negotiation (RN) and Conflict Resolution (CR)](image)

4.5.2. Preparatory activities with following interaction media to supports effective Requirements Negotiation in Distributed Software Development.

Scale used: A six scale measurement is used to collect the data from the respondents, the scale ranges from 5-0 with the options (Completely agree-5, Agree-4, Neutral-3, Disagree-2, Completely disagree-1 and Did not use it as 0.)

The end goal of this section is identify the effective interaction media for the preparatory activities in the Requirements negotiations, the list of following interaction Medias are obtained from the literature studies. Respondents are asked to depict their level of agreement from their experience for each media that supports effective requirement negotiation in distributed software development. The results obtained are examined, analyzed and presented with the bar graphs. Figure 9 shows the agreement of the respondents for the following interaction media to conduct preparatory meetings for Requirements Negotiation. The figure depicts the comparison between the interaction media Face to Face (Co-located) meetings, Video Conferencing meetings and Meetings through the asynchronous communication tool like email and IBIS (Internet tool supports asynchronous discussions). In Figure 9 the overall column represents the combined rating given by the both clients and suppliers. However, a stratified comparison is also shown to illustrate the variance between clients and supplier’s agreement toward to following media’s.
From the Figure 9 it is observed that face to face communication is rated as the more effective communication for preparatory activities in performing requirements negotiation, it has 100% (calculated by adding the agreement percentage of Completely agree and Agree scales) of agreement form clients and suppliers. Video conferencing tools are next agreed communication media by the clients and suppliers with agreement rate of 97% for preparatory activities and Asynchronous media’s such as email and IBIS tools are rated with the lowest agreement rate 60% by clients and suppliers for preparatory activities.

4.5.3. Communication tool for effective support to perform Requirements negotiation in Distributed Software Development.

The focus this section is to know the communication tool for effective support to perform Requirements negotiation in distributed software development according the experience of practitioners. Literature studies proposed following communicational media for industrial practices, Asynchronous email [S3] and [S6], Asynchronous IBIS tool [S3], Team wave (Tele data + Telepresence) [S8], Telephone [S10] Text based communication [S5] and video conference [S12, S19, and S20].
IBIS tool (supports asynchronous communication) received equal level of agreement from both suppliers and clients. Instant text messenger is least agreed communication tool by all the respondents and these findings contradicts the results of an empirical study [S10].
However, these are few possible reasons for variance in the level of agreement between the clients and suppliers but in-depth study is recommended to identify the reasons for change of agreement levels in the communication medium for requirements negotiation in distributed software development.

Analysis: Figure 10 shows the agreement of the respondents for the following communicational tools that supports effective requirements negotiations. It is observed that videoconference tool has highest agreement rate of 95%, following Team wave 87%, Telephone 85%, email 84%, IBIS tool 63% and Instant text messenger 44%. This level of agreement is calculated by summation of ‘Completely agree’ and ‘Agree’ values given by the respondents.

Slight variance in the level of agreement between clients and suppliers is observed which resulted the following order of agreement. Clients: Email 100%, Video 90%, and Telephone 80%, IBIS 80%, Team wave 80%, Instant text messenger 40%. Suppliers: Video conference 96%, Team wave 90%, Email 89%, Telephone 86%, IBIS 61%, and Instant text messenger 46%.

### 4.5.4. Models that provides good support to perform Requirements Negotiation in Distributed Software Development.

Similar to the communicational tools literature studies suggested the use of following models Arena II (an asp.net tool that support asynchronous participation of clients and suppliers) and Arena M (extension to Arena II but works on mobile browser) for performing requirements negotiation in distributed software development [S9] and found no additional information regarding use of these models in industrial environment.

Figure 11 depicts the results of the survey related to the industrial usage of the following models to perform the requirements negotiation activities.

![Figure 11 Respondents rating for the models to perform distributed Requirements negotiations](image-url)
The results show that both models Arena II and Arena M are not widely recognized models. Overall, more than 50\% of the respondents never used any of these models. A minority (37\% for Arena II and 29\% for Arena M) agree that models provide good support in requirements negotiations.

4.5.5. Factors affecting Requirements Negotiation in Distributed Software Development

The focus of this section is to identify the affecting factors of Requirements negotiations in distributed software development, since literature studies stated that Requirements Engineering activities in global software engineering are affected by the factors like cultural diversity, inadequate communication, and time difference [S2]. List of the identified 9 factors from the literature is provided to the respondents and asked them to rate on a scale 5-1 (Completely agree-5, Agree-4, Neutral-3, Disagree-2, Completely disagree-1).

Figure 12 depict an overview of the factors that affects the requirements negotiations in distributed software development.

<table>
<thead>
<tr>
<th>Name of factor</th>
<th>Overall agreement (%)</th>
<th>Clients agreement (%)</th>
<th>Suppliers agreement (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common understanding of the requirements</td>
<td>92</td>
<td>90</td>
<td>93</td>
</tr>
<tr>
<td>Domain knowledge</td>
<td>94</td>
<td>90</td>
<td>97</td>
</tr>
<tr>
<td>Trust</td>
<td>89</td>
<td>80</td>
<td>92</td>
</tr>
</tbody>
</table>
From the Table 14 it is possible to observe the level of agreement of the clients and suppliers for the following factors that affects requirements negotiations in distributed software development. The color coding in the table represents the Highest level (Green color) and lowest level (Orange color) of agreement. This agreement levels are achieved by summation of values ‘Completely agree’ and ‘Agree’ scale given by the respondents.

When overall agreement rate is considered *Common understanding of the requirements* considered as the highest level of agreement (92%) that affects requirements negotiation in distributed software development, but when looking the individual agreement levels clients and suppliers have little variance in the agreement levels. Clients rated the following factor with agreement rate (90%) and supplier’s agreement level as (93%).

*Trust factor* rated next with overall agreement level (89%) that affects requirements negotiation distributed software development, when individual agreement is considered 12% of variance is observed between the agreements of supplier and clients. According to the supplier’s experience trust factor is the second agreed factor that has effect on requirements negotiations.

*Time difference* between the clients and suppliers received overall third position in the level of agreement by the clients and suppliers that affects requirements negotiation in distributed software development, both clients and suppliers have same level of agreement on this factor.

Domain knowledge received overall fourth place in affects factors on the requirements negotiations, when individual agreement is taken into notice supplier’s ranked domain knowledge with highest agreement level as affecting factor on the other hand clients also ranked highest agreement level for the following factor.

Communication medium received fifth agreed factor that affects requirement negotiation activity with overall agreement level of 84%, slight variance is observed between the clients and supplier agreement. 86% of Suppliers agreed with the factor where as 80% of clients.

Communication setup cost and Cultural difference falls in sixth and seventh places next to domain knowledge with same overall agreement level (76%), there is slight variance in the agreement levels between clients and suppliers. 80% of Clients agreed to communication setup cost being affecting factor on the other hand 65% of suppliers agrees on this factor.

Cultural difference has 76% overall agreement level and slight variance is observed between the clients and supplier’s agreement level, 5% of higher agreement level is noticed from client’s point of view.

Language difference rated as next agreed factor that affects the requirements negotiations activities, it has overall agreement rate of (73%). However, it is found that there is variance on the level of agreement between clients and suppliers, client’s agreement levels are 10% higher than suppliers 70% of agreement level.

Geographical distances received an overall (64%) level of agreement, however slight variance is observed in clients and supplier’s agreement. Suppliers agreed about the factor with 79% and whereas clients rated it with 70% agreement rate.

<table>
<thead>
<tr>
<th>Communication medium</th>
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<tbody>
<tr>
<td></td>
<td>84</td>
<td>80</td>
<td>86</td>
</tr>
<tr>
<td>Geographical distances</td>
<td>64</td>
<td>70</td>
<td>79</td>
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<tr>
<td>Time differences</td>
<td>89</td>
<td>80</td>
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<tr>
<td>Language difference</td>
<td>73</td>
<td>80</td>
<td>70</td>
</tr>
<tr>
<td>Culture difference</td>
<td>76</td>
<td>80</td>
<td>75</td>
</tr>
<tr>
<td>Communication setup cost</td>
<td>76</td>
<td>80</td>
<td>65</td>
</tr>
</tbody>
</table>

*Table 14 shows the overall and individual agreements of clients and suppliers*
4.5.6. Preparatory activities for effective Conflict resolution in Distributed Software Development

Similar to Requirements negotiations, the end goal of this section is identify the effective interaction media for the preparatory activities in the Conflict resolutions, the list of following interaction medias are obtained from the literature studies. Respondents are asked to depict their level of agreement for each media that supports effective conflict resolution in distributed software development. The obtained results are examined, analyzed and presented in the bar graphs

Figure 13 shows the agreement of the respondents for the following interaction media to conduct preparatory meetings for Conflict resolution in Distributed Software Development.

Literature suggested preparatory activities before actual conflict resolution meetings and use of Video conference [S1], Email [S10] and Face to Face interactions [S20] are recommended. However, there is no information regarding the usage of these interaction media’s in industrial environment for the preparatory activities. A six scale measurement is used to collect the data from the respondents, the scale ranges from 5-0 with the options (Completely agree-5, Agree-4, Neutral-3, Disagree-2, Completely disagree-1 and Did not use it as 0). Figure 13 shows the agreement of the respondents for the following interaction media to conduct preparatory meetings for Conflict Resolution in distributed software development.

![Preparatory activities for Conflict Resolution](image)

*Figure 13 Interaction media for preparatory activities in Conflict resolution*

In Figure 13 the overall column represents the combined rating given by the both clients and suppliers. However, a stratified comparison is also shown to illustrate the variance between clients and suppliers.

From the analysis of results, it is observed that Video conferencing media for the preparatory meeting with has majority of agreement 91% followed by Face to Face interaction interactions with 85 % of agreement and email interaction received 69% agreement.
When individual agreement levels are considered a slight variance in the agreement of clients and suppliers on email communicational tools is observed. The agreement levels of clients are 27% higher than supplier’s for email communication tool.

4.5.7. Communication tool for effective support to perform Conflict resolution in Distributed Software Development

According to the literature studies, these communicational tools are suggested for the Conflict Resolution in distributed software development, Video conference [S1], email [S10], Telephone [S10] and Instant messenger [S10]. There is no information regarding validation of these tools in industrial context, and present study is aimed to validate them. List of following tools are provided to the respondents and asked to give their agreement accordingly that provides effective support for Conflict resolution in distributed software development.

Figure 14 the overall column represents the combined rating given by the both clients and suppliers. However, a stratified comparison is also shown to illustrate the variance between clients and suppliers.

From the following results it is observed that video conferencing tools are widely agreed communicational tool by the clients and suppliers it had overall 97% agreement level, even it has individual higher agreement levels.

When overall agreement levels are considered communication through telephone has next high agreement level 89%, both clients and suppliers has similar agreement on this communication media.

Email has the next overall agreement level of 83%, both clients and supplier’s same agreement levels on this communication media.

Instant text messenger is least agreed communication tool for the effective conflict resolution, it has received overall 25% agreement and 32 % of disagreement. But 56% clients agreed to use Instant text messenger for effective communication in conflict resolution.
4.5.8. Factors affecting the Conflict resolution in Distributed Software Development.

Literature studies stated that RE activities in global software engineering are affected by the factors like cultural diversity, inadequate communication, and time difference [S2], however there are no studies that tried to identify the affecting factors of Conflict resolution in distributed software development. List of the factors are given to the respondents and asked to rate them on a scale of 5-1 (Completely agree-5, Agree-4, Neutral-3, Disagree-2, Completely disagree-1). Figure 15 depict an overview of the factors that affects the requirements negotiations in distributed software.

![Factors affecting Conflict Resolution](image)

*Figure 15 Factor affecting Conflict resolution*
Factors | Overall agreement (%) | Clients agreement (%) | Suppliers agreement (%)
--- | --- | --- | ---
Level of domain knowledge | 97 | 90 | 96
Common understanding of requirements | 91 | 100 | 87
Communication medium | 91 | 89 | 92
Trust factor | 88 | 89 | 89
Time difference | 83 | 89 | 81
Language difference | 82 | 89 | 81
Communication setup cost | 80 | 78 | 81
Geographical distance | 77 | 78 | 77
Cultural difference | 80 | 89 | 80

*Table 15 showing the percentage (%) respondents agreements.*

From the Table 15 it is possible to observe the level of agreement of the clients and suppliers for the following factors that affects conflict resolution in distributed software development. The color coding in the table represents the Highest level (Green color) and lowest level (Orange color) of agreement. This agreement levels are achieved by summation of values ‘Completely agree’ and ‘Agree’ scale given by the respondents.

When overall agreement rate is considered Domain knowledge received highest level of agreement 97% that affects conflict resolution in distributed software development, but when looking the individual agreement levels clients and suppliers have little variance in the agreement levels. Clients rated the following factor with agreement rate 90% and supplier’s agreement level as 96%.

Common understanding of the requirements received next highest rating as affects factors of conflict resolution with 91% overall agreement level, when individual agreement is taken into notice client’s ranked Common understanding of the requirements with highest agreement level as affecting factor on the other hand supplier has 87% of agreement level.

Communication medium considered as next agreed factor that affects conflict resolution activity with overall agreement level of 84%, slight variance is observed between the clients and supplier agreement. 86% of Suppliers agreed with the factor where as 80% of clients.

Trust factor received next place with overall agreement level 88% that affects conflict resolution distributed software development, both clients and suppliers has same level of agreement on this particular factor that affects conflict resolution.

Time difference between the clients and suppliers received overall fifth position with 83% level of agreement by the clients and suppliers that affects conflict resolution in distributed software development, slight variance in the level of agreement is observed clients rated 8% higher than suppliers for the following factor.
Language difference rated as next agreed factor that affects the conflict resolution activities, it has overall agreement rate of 82%. However, it is found that there is variance on the level of agreement between clients and suppliers, client’s agreement levels are 8% higher than suppliers 81% of agreement level.

Communication setup cost and Cultural difference falls in sixth and seventh with same overall agreement level 80%, there is slight variance in the agreement levels between clients and suppliers. 78% of clients agreed to communication setup cost being affecting factor on the other hand 81% of suppliers agrees on this factor.

Cultural difference has 80% overall agreement level and slight variance is observed between the clients and supplier’s agreement level, 9% of higher agreement level is noticed from client’s point of view.

Geographical distances received an overall 77% level of agreement, Suppliers and clients have same agreement level for the following factor.

4.6. Survey Analysis
This survey analysis is carried in way to answer the research questions by comparing the contribution and available research work.

4.6.1. Current state of practices on interventions used by the software practitioners to perform Requirements negotiations in Distributed Software Development.
This section is aimed to identify the current state of practices performed by the practitioners to perform Requirements negotiations in distributed software development. Survey analysis answers the research

Preparatory activities for requirements negotiation sin distributed software development
According the experiences of the practitioners, Face to Face interactions are the most preferred communication medium for the preparatory activities. Richness of the communication medium [S6], satisfaction levels in perform requirements negotiation[S18] and Less time to perform requirements negotiations [S7] can be possible reasons for the agreement. This results supports the statement of the studies [S1], [S19] and [S20] suggesting the importance of face to face interaction prior to actual requirements negotiations.

Apart from Face-to-Face interactions, practitioners use synchronous (video conference) communication tool for preparatory activities, Video conference tools can act as next alternative to Face-face interactions since it is observed that only 3% of variance in agreement of practitioners is found in between the bot communication media’s from the survey results.

This research found that the use of asynchronous (email and IBIS) communication tools are less preferred by practitioners for the preparatory activities. It is observed that 60% of practitioners agreed to use these tools for effective communication which support the findings of [S4] studies, however this research found that these communicational tools are not effective than the synchronous (video conference) or traditional (Face-to-Face) communication media’s.

Communicational tools for effective requirements negotiation in Distributed Software Development.
The survey results show that Video conference tools are most agreed tool that supports effective communication for Requirement negotiations in distributed software development, this supports research findings of the studies [S12], [S14] and [S20]. However, slight variance in agreement is observed between the client and suppliers as clients agreed to email as most effective communication tool in first place, one of the client had backed his agreement with a reason “Most of the times the requirements gathered are documented for traceability purpose and email conversation are more feasible for documenting” and study [S13] claimed email as dominant of all asynchronous tools due to the time difference between the clients and suppliers can be the possible reason for change of preference.

TeamWave tools (Tele data + Telepresence) received same level of agreement by the clients and suppliers, however only one study [S8] proposed the use of TeamWave for requirements negotiation in distributed software development. But in practitioner context it is the second agreed tool of effective requirements negotiations.
Telephonic tools are next agreed communication tool to perform effective requirements negotiation. According to the study [S10] use of telephonic conversations in requirements negotiations and conflict resolution resolves the ambiguity can be a possible reason.

**Models for effective requirements for effective requirements negotiation in Distributed Software Development.**

According to the study [S9] Arena II and Arena M are the models that supports effective requirements negotiations in distributed environment however literature has no evidence on industrial usage of this models, and through this survey study author provided required information regarding these two models. As said earlier in results these models are not widely recognized models, a very minority of the respondents agreed upon the using of these models.

Respondent from supplier had given following reason for not using the any models as ‘No specific models are used for the requirements negotiation in distributed software development, moreover negotiations are made basing on the deliverables in the fixed timespan and technical feasibility’.

**Factors affecting requirements negotiations in Distributed Software Development.**

Common understanding of the requirements is the highest agreed affecting factor by the practitioners, suppliers rated this factor slightly higher than the clients when individual agreement levels are considered. This can be depicted as suppliers are more conscious and particular about the establishing common understanding of the requirements with clients. There is a possibility that preparatory activities prior to requirements negotiations meetings can establish common ground between clients and suppliers.

Trust factor is considered as the next highest agreed effecting factor for requirements negotiations activities, a 12% of higher agreement levels by suppliers than the clients is noticed in the survey results. Possible assumptions can be made with the results that suppliers are more concerned about the trust factors with the clients and this trust factors can be highest priority according suppliers in requirements negotiations in distributed software development.

Time difference is next affecting factor to perform requirements negotiations, client and suppliers have same level of agreement on this particular factor. Possible assumption can be made that practitioners are suffering with the time difference to adjust the staff working hours and limitation with availability when clients and suppliers have different time zones.

Domain knowledge is one of the important affecting factor according to the clients and supplier, possible assumptions are that it is necessary to have domain knowledge to understand and to analyze the technical hiccups and this very important in requirements negotiations because most often negotiations requires prior knowledge to be able handle the requirements negotiation.

Communication medium is next affecting factor basing on the agreement of the clients and supplier, however suppliers are more concerned about the communication medium because 6% of higher agreement levels than clients are observed. Possible assumption for the variance can be that opportunity to participate and expressing more openly according to the study[S11] can be one of the reason since requirements negotiations are communication oriented activity.

Communication setup cost next affecting factor basing on the agreement of the clients and supplier, but 20% of variance in the agreement between the client and suppliers is observed, 80% of Clients agreed to communication setup cost being affecting factor on the other hand 65% of suppliers agrees on this factor. From this results it is evident that that clients are suffering from this particular factor and there is a need for further investigation on the root causes and mitigation strategies.

Cultural difference is considered as next affecting factors basing on the agreement of the clients and supplier, a slight difference in the agreement level are observed between the clients and suppliers. Clients rated 5% higher than the supplier’s agreement level for the following factor. Possible assumption can be that cultural difference have many attributes that impacts the success of the project, it limits the individual in expressing and clarifying the complications.
Language difference rated as next agreed factor that affects the requirements negotiations activities, however it is observed that there is variance on the level of agreement between clients and suppliers, client’s agreement levels are 10% higher than suppliers 70% of agreement level. Possible assumption can be time and effort required to explain the requirements can be influenced by the languages difference, commonality in the languages can eases the explaining and understanding of complications.

Geographical distance is the least ranked factor according to the agreement levels of clients and suppliers, however slight variance is observed in clients and supplier’s agreement. Suppliers rated the factor with 9% higher agreement level than clients. Possible reasons for variance can be that geographical distances are associated with the complication like Cost, time and effort required to travel, video conferencing tools may not always resolve the complication and further it requires face-to-face interaction.

4.6.2. Current state of practice on the interventions used by software practitioners to perform Conflict Resolution in distributed software development.

Preparatory activities for conflict resolution in distributed software development
According to the experience of respondent’s video conferencing tools are most effective for the preparatory activities in conflict resolution. The study results support the research findings of [S1]. One of the respondent had provided a reason for his agreement ‘Conflict can be resolved over video conference, because most of the times these requirements are well known or earlier discussed and requires less time to understand’, this can be the possible reason for high agreement levels 91% from the respondents.

Face to face interaction media received 85% agreement level and stands next to video conferencing in effectiveness to perform preparatory activities to perform conflict resolutions, three respondents provided additional information through the text field stating that ‘in few situations face-to-face interactions are essential to resolve conflicts’ which can possible reason.

Email interaction media is less agreed tools for preparatory activities that supports effective conflict resolution, it received an overall 69% agreement level but slight variance in observed between the agreement of client and supplier. More than 89 % of clients agreed email for the preparatory activities but only 62% of suppliers agreed to use the interacting media. According to study [S11] stakeholders prefer computer mediated communication, since they provide increased opportunity and more open participation can be one of the reason for the variance in the agreement.

Communicational tools for effective conflict resolution in distributed software development.
According to the agreement level given by the respondent’s video conference tool provide effective support to perform conflict resolution in distributed software development. It received high agreement rate of 97% and both clients and suppliers has nearly same agreement levels. The results of this study supports the suggestion of research study [S1] stating that multimedia meetings are effective than traditional face to face meetings.

Telephone communication is considered as the next communication tool that support effective conflict resolution, overall 89% of respondents agreed it as effective tool and individual agreement levels of the client and suppliers have nearly agreement. However, this results partially supports the research finding of study [S10], stating that ambiguity can be resolved by using telephone, email and instant text messenger.

Email has next agreement level as the effective tool to perform conflict resolution it had received overall 83 % of respondent agreement. Clients and suppliers have same level of agreement to the following tool. Possible reason can be that email are better suited for conveying information about the planning activities in distributed conflict resolutions [S3] and [S10].

Instant text messenger is less agreed tool for effective conflict resolution activity which contradicts the findings of study [S10], Instant text messenger received an overall agreement level of 25% which can be least agreed tool comparatively, however when individual agreement levels are assessed 56% of clients agreed that these communication tool provides effective support where only 27% of suppliers agreed to it.
Factors affecting conflict resolution in distributed software development
According to the experience of the respondent’s domain knowledge is considered as the most affecting factor of conflict resolution distributed software development, it received highest level of agreement (97%) but when individual agreement levels of clients and suppliers assessed suppliers agreed to the following factor with slightly higher 96% of agreement than client 90%. Possible reason can be that supplier needs to explain the technical limitations to the clients in more elaborated way to understand the complexity, this requires more effort and time.

Common understanding of the requirements next affecting factor of conflict resolution, it has agreement level of 91% and when individual agreement is taken into notice client’s ranked Common understanding of the requirements with highest agreement level 100% as affecting factor on the other hand supplier had given 87% of agreement level. This shows that clients are little worried about common understanding of requirements in conflict resolution, possible reason can be missing common ground in the requirements can lead to developing a product that doesn’t meet user needs.

Similar to the research findings of the requirements negotiations, conflict resolution also suffers with communication medium being an affecting factor. It has overall agreement level of 84%, and slight variance in the agreement levels of clients 80% and 86% suppliers agreed to the following factor. Possible assumption for the variance can be that supplier may not feel comfortable in expressing due to communication barriers.

Trust factor is considered as the next affecting factor of conflict resolution an overall 88% agreement level are observed and both suppliers and clients have same agreement levels on the following factor. The possible assumption can be that this factor has impact on the relationship between the clients and suppliers.

Time difference between the clients and suppliers considered as the next affecting with 83% of agreement level, a slight variance between the agreements of client and supplier is noticed. Client rated the following factor 8% higher than the suppliers. Possible assumption can be made that practitioners are suffering with the time difference to adjust the staff working hours and limitation with availability when clients and suppliers have different time zones.

Language difference is next agreed factor that affects the conflict resolution activities, it has overall agreement rate of (82%). However, it is found that there is variance on the level of agreement between clients and suppliers, client’s agreement levels are 8% higher than suppliers 81% of agreement level. Possible assumption can be time and effort required to explain the requirements can be influenced by the languages difference, commonality in the languages can eases the explaining and understanding of complications.

Communication setup cost and Cultural difference falls in sixth and seventh with same overall agreement level (80%), there is slight variance in the agreement levels between clients and suppliers. 78% of clients agreed to communication setup cost being affecting factor on the other hand 81% of suppliers agrees on this factor. From this results it is evident that that clients are suffering from this particular factor and there is a need for further investigation on the root causes and mitigation strategies.

Cultural difference has 80% overall agreement level and slight variance is observed between the clients and supplier’s agreement level, 9% of higher agreement level is noticed from client’s point of view. Possible assumptions are cultural difference limits the practitioners to limited boundaries while expressing and comfort levels to explain will be very low.

Geographical distances received an overall (77%) level of agreement, Suppliers and clients have same agreement level for the following factor. Possible reasons for variance can be that geographical distances are associated with the complication like Cost, time and effort required to travel, video conferencing tools may not always resolve the complication and further it requires face-to-face interaction.
4.6 Discussion

Face-to-Face interaction is better than synchronous and asynchronous communication for preparatory activities in Requirements Negotiations

This research study made clear that industrial practitioners perform preparatory activities for requirements negotiation and found face-to-face communication is better than synchronous (videoconferencing) communication and asynchronous (email and IBIS) communication for preparatory activities for requirements negotiations in distributed software development. It is found that synchronous video conferencing tool can be next alternate after face-to-face interaction in the experience of practitioner. However, asynchronous communication through email and IBIS tools are less considered by the industrial practitioners.

Synchronous (Video conferring) tool for effective requirements negotiations

This study revealed that the video conferencing tools provide effective communication to perform requirements negotiations in distributed software development, apart from it this study succeeded in revealing that Teamwave tools are next highly agreed tools by the practitioners for effective communication which is unnoticed before this study. Telephonic communication is next considered communication for the requirement negotiation according to the practitioner agreement level.

Difference in choice of communication tool for effective requirements negotiations

This study noticed difference in the choice of communication for effective requirements negotiations between the clients and suppliers. Clients consider email as the primary communication media for negotiations activities due to its ability of documentation. Suppliers consider video conference as the primary communication source because of its ability to participate and easy expressing. However, there is a need to investigate the reasons for change of communication media in future studies.

Communication through IM (Instant text Messengers) for effective requirements negotiations

It is revealed that communication through IM (Instant text Messengers) for effective requirements negotiations is least agreed communication tool. The findings of this research contradicts with the results of study [S10] which proposed IM for effective communication for requirements negotiations in distributed software development.

No models are used to perform requirements negotiations

Literature studies suggested the use of negotiation models Arena II and Arena M for requirements negotiations in distributed software development, however this study identified that no models are used to perform requirements negotiations and often negotiations are made basing on the deliverables in the fixed timespan and technical feasibility.

Requirements negotiations suffering from knowledge Management

This study made clear that requirements negotiations in distributed software development is suffering from knowledge management issues. Clients and supplier highly agreed on the factors that like Common understanding of the requirements and level of domain knowledge are the two affecting factors of requirements negotiations in distributed software development According to the one of the supplier ‘Clients may not have the domain knowledge or the technical experience, due to that reason it’s our responsibility of explaining and convincing them according. In many cases clients have vague idea on what they exactly require’ which can be one of the reason for the following factors.

Face-to-face interactions are essential in conflict resolution

Though video conference tools provide effective support in preparatory activities, few times face-to-face interactions are essential to resolve conflict in distributed software development, three respondents reported the need of the face-to-face interactions in preparatory activities.
Discussions with respective to research questions

RQ4: What is the current state of practice on the interventions used by the software practitioners to perform requirements negotiations in distributed software development?
   a. What are the preparatory activities used prior to actual negotiation meetings?
   b. What are the tools/models used to perform Requirements negotiations?
   c. To what extent does the experience of the clients and suppliers differ on Requirements negotiations tools/models/preparatory activities?

And

RQ6: What are the factors affecting the Requirements Negotiations in distributed software development?
   a. To what extent does the agreement of the clients and suppliers differ on the factors affecting Requirements negotiations?

Most of the studies identified in the literature studies are mainly focused on the communication tools Seven studies [S3, S6, S8, S9, S12, S14 and S20] proposed interventions to perform requirements negotiation activities in distributed software development and eleven studies [S1, S2, S4, S5, S7, S11, S13, S15, S18, S19 and S20] made their recommendations and conclusion on the use of communicational interventions to perform requirements negotiations. Literature suggested preparatory activities before actual negotiation meetings in the distributed software development and the given list of the interaction media, due to the unavailability of the information regarding the industrial usage of these tools, author tried to validate them by this survey study and found the effective media for preparatory activities. Survey results shown that these media are used in the industrial context and among these Face to face collocated interactions supports effective preparatory activities. However, studies suggest use of different medias, industrial practitioners prefer collocated interactions. After collated interactions Video conferencing tools are most preferred interaction media for preparatory activities and at last use of asynchronous communication tools such as email and IBIS tools are less preferred for the preparatory meeting.

Literature studies stated the use of the following tools for effective requirements negotiations in distributed environment, studies like S1, S3and S4 argued asynchronous communications tools provide effective support for negotiation activities and Studies S12,S19 and S20 claimed video conferencing tools provide better support in industrial negotiation practices, but the real question is are these all communications are used in industrial practices and what are the communicational tool that provides effective support for negotiation activities. Survey results answered these questions majority of the respondents agreed with video conference as the effective communication for requirements negotiation activities and asynchronous email tools are next agreed tool among the list of tools instant text messenger is least agreed tool for the requirements negotiations in industrial context.

Study S9 claims Arena M and Arena II models supports effective requirements negotiation in distributed software development but survey results shown these models are not widely popular and more than 50% of respondents never knew this model. One of the respondent stated that no more arte used for the requirements negotiation activities.

Factors affecting the requirements negotiations, few factors are identified during literature review related to requirements engineering practices, author tried to identify whether these factors imply on requirements negotiation in Distribute Software Development. This survey has given an overview the affecting factors among that affects the requirements negotiation activities according the respondents common understanding of requirements and level of domain knowledge are most affecting factors and communication setup cost are least affecting factors. Apart from these finding survey manage to identify one more factors ‘Power factors: In many cases clients force suppliers for additional functionalities without knowing the technical limitations’

RQ.5. What is the current state of practice on the interventions used by software practitioners to perform Conflict Resolution in distributed software development?
   a. What are the preparatory activities used prior to actual negotiation meetings?
   b. What are the tools used to perform Conflict resolution?
   c. To what extent does the experience of the clients and suppliers differ on Conflict resolution tools/models/preparatory activities? AND
RQ.6. What are the factors affecting the Conflict Resolution in distributed software development?

a. To what extent does the agreement of the clients and suppliers differ on factors affecting Conflict resolution?

Study S1 suggested usage of video conference tool for conflict resolution in distributed software development, and study S10 suggested use of telephone, Instant text Messenger and email for the conflict resolution in distributed software development. However, no further information was found on the usage of these communication media in industrial context.

Survey study identified the industrial practices and provided the list of following tools video conference provides effective support in preparatory activities and as communication media in conflict resolution activities. Asynchronous email communications are next preferred media for effective communication support. Factors affecting conflict resolution activities in distributed software development, the survey results show similar results as requirement negotiations common understanding of the requirements and level of domain knowledge are the two affecting factors according to the respondents.

Implications for practitioners
The results of this study is intended to help industrial practitioners by providing the information regarding the requirements negotiation and conflict resolution interventions that are used in the most of companies. This information regarding tools should help the organization and practitioners in early planning of the requirements negotiations and conflict resolution activities in the product development. By selecting the affective interventions results in the effective communication while facilitating with clients and suppliers. According to literature studies this early planning of both activities results in improved collaboration and financial benefits [S2].

Implications for researchers
This research study should be considered as the starting point for the researchers trying to investigate the effective requirements negotiations and conflict resolution. Though there are several advancements in the research to facilitate clients and suppliers, but industrial practitioners are still preferring the traditional Face-to-Face interactions, TeamWave tools which are identified in the beginning stages of the literature to perform requirements negotiations and conflict resolution activities in the distributed software development. It is researcher’s responsibility to know the actual reasons to settle down with long back interventions, why the industrial practitioners are not adopting the change like using new interventions, what do researchers should think to bring this gap?
In this study, it also found that there is variance in the agreements of the clients and suppliers on interventions for effective requirements negotiations and conflict resolution in distributed software development, researchers should know the reasons behind variance from the both prospective of clients and suppliers.

5 Conclusion

Brief summary of the thesis
This study is started with the aim of structuring of the available information on requirements negotiations and conflict resolution in distributed software development, systematic mapping studies are considered for the purpose because of its ability of structuring the research area. Performing literature study on databases identified 20 relevant studies, analyzing these studies revealed that research is more focused on the communication in performing requirements negotiations and conflict resolution in distributed software development. In all the selected studies, researchers tried to contribute their efforts to support effective communication.
This literature analysis helped to gain knowledge regarding literature proposed interventions like activities, communicational tools and model for effective requirements negotiations and conflict resolution in distributed software development.

- The results of literature studies identified the following
- Suggestions regarding preparatory activities prior to requirements negotiations and conflict resolutions.
- Synchronous and asynchronous communication tools to perform effective requirement negotiations and conflict resolutions.
- Models purposed for industrial practitioners to perform requirement negotiations and conflict resolutions.

In the further analysis of literature results it is found that most of the findings are outcomes of the experimental studies using academic students as the participants and academic setup as environment, except communication tools(email), rest of the purposed communicational tools are missing the industrial validation and there is no relevant information regarding the interventions (Preparatory activities, communicational tools and models) that support effective requirements negotiations and conflict resolution. This lacking of information regarding the validation of interventions that supports effective requirements negotiation activities and conflict resolution activities called for a further study, to meet the need survey is considered and its ability to collect data from large population and analyzing capabilities made this method best suit for the research.

Apart from the validation of literature findings, author tried to identify the affecting factors of requirements negotiations and conflict resolution in distributed software development. The end results of the survey shown the validation of the literature proposed interventions and information regarding the effective interventions for requirements negotiations and conflict resolution activities in distributed software development.

This study also investigated the largely unexplored area of requirements negotiations and conflict resolution in distributed software development. It is important because requirements negotiations and conflict resolution helps distributed teams to develop common ground, which is always challenging due to innate communicational limitations and gaps in geographically dispersed teams [S3].

The results of this research has identified all available and effective interventions to perform requirements negotiations and conflict resolution in distributed software development. In particular, this empirical study is mainly a preliminary exploration aimed at investigating the industrial insights of performing requirements negotiations and conflict resolution in distributed software development.

This study identified and validated communicational media, tools, preparatory activities and models used for requirements negotiations and conflict resolution in distributed software engineering. This study also succeeded in identifying the effective communicational tools, interaction media’s, and specific aspects like affecting factors of requirements negotiations and conflict resolution in distributed software development that may not have been accounted by any previous studies in particular research area.

Author believed that these investigations helps in structuring the research area, in particular available information about facilitating the distributed teams with effective interventions for requirements negotiations and conflict resolution. This information helps the organization in early planning of the requirements negotiation and conflict resolution activities in software development, this helps organization to improve collaboration and to yield economic benefits[S2].

Author believe that this research represents only a start in understanding what are the available interventions supports effective distributed requirements negotiation and conflict resolution. Further research, which should include studies of real time approaches and practices followed by the practitioners for effective requirements negotiations and conflict resolution

Following issues are to be considered by the researchers in their future studies:
What are the reasons for variance in the choice of selecting communicational tools between the clients and suppliers?
Do practitioners use combination of multiple communicational media for effective requirements negotiations and conflict resolution?
Do practitioners follow any guidelines in selecting communication medium for requirements negotiations and conflict resolution? Why and how does selection of communicational intervention changes? Do they have any particular recommendations to change communication media with respective to situation?
What are the mitigation strategies to overcome the affecting factors of requirements negotiations and conflict resolution?
6 References


Appendix A: Survey Questionnaire

Dear Respondent,

I am Chaitanyakumar Velpula, pursuing Masters in Software Engineering at Blekinge Institute of Technology, Sweden. This survey is conducted as part of my Master Thesis, focusing on exploring the “Industrial Requirements Engineering practices of Requirements Negotiations and Conflict Resolution activities in Distributed Environment”. I would be very grateful if you could participate in the survey and provide your response based on Industrial experience, which takes 10 minutes of your valuable time.

Link for the survey  http://goo.gl/forms/YldNmlZ7qx

Thanking you,
Chaitanyakumar Velpula.
M.Sc. In software Engineering,
Blekinge Institute of Technology, Sweden.
Industrial Practices of Requirements Negotiation and Conflict Resolution in Distributed Environment

The aim of the study is to explore the Requirements Engineering practices of Requirements Negotiation activities in Industries when clients and suppliers are resided in Distributed environment. *Required

1. **What role does your company primarily take?** *
   Client (Outsource/offshores development) or Supplier (that develops software for a client)
   - **Client Skip to question 2.**
   - **Supplier Skip to question 3.**

Requirements Negotiation is a collaborative activity where clients and suppliers strive to achieve common ground and agreement on software requirements which happens in the same place, same time and with face-to-face interactions. This is no longer possible in geographical distributed software development and gave rise to “Distributed Requirements Negotiations” where clients perform negotiations being in different locations.

2. **Do you perform Distributed requirements negotiations with your suppliers / clients?** *
   Mark only one oval.
   - **Yes, Skip to question 8.**
   - **No Skip to question 29.**
   - **Other: Skip to question 8.**

Requirements Negotiation is a collaborative activity where clients and suppliers strive to achieve common ground and agreement on software requirements which happens in the same place, same time and with face-to-face interactions. This is no longer possible in geographical distributed software development and gave rise to “Distributed Requirements Negotiations” where clients perform negotiations being in different locations.

3. **In which role were you involved in Distributed Requirements negotiations and Conflict resolution activities?** *
   Your job profile while performing requirements negotiations and conflict resolution activities in Distributed environment.

4. **For how many years you are working in this role?** *
   Since, how long you are working in the role?

5. **In which country is your company is located?** *

6. **In which country are your clients / suppliers located?** *
   Location of your clients, choose more than one country if you have many clients. *Tick all that apply.*
7. In my experience, preparatory activities with following interaction medium supports effective Distributed Requirements Negotiation activities with clients / suppliers. *  
Preparatory activities can be interaction with suppliers prior to actual Distributed Requirements Negotiations meetings; An activity is effective if it leads to the targeted goal. 
*Mark only one oval per row.*

<table>
<thead>
<tr>
<th>Interaction Medium</th>
<th>Completely agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Completely disagree</th>
<th>Did not use it</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face to face(collocated) interactions</td>
<td></td>
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<tr>
<td>Video conferencing interactions</td>
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<tr>
<td>Asynchronous interactions through email and IBIS (Internet tool supports asynchronous discussions)</td>
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</tbody>
</table>

If you use another Interaction medium, please describe and rate it using the scale from the above question __________________________________________________________

8. In my experience, this communication tool from following list provides effective support to perform Distributed Requirements Negotiation activities with clients / suppliers. *  
Tools that provides good communication support to perform Distributed requirements negotiation activities; An activity is effective if it leads to the targeted goal 
*Mark only one oval per row.*

<table>
<thead>
<tr>
<th>Communication Tool</th>
<th>Completely agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Completely disagree</th>
<th>Did not use it</th>
</tr>
</thead>
<tbody>
<tr>
<td>Email</td>
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<tr>
<td>Instant text messenger</td>
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<tr>
<td>IBIS (Internet tool supports asynchronous discussions)</td>
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<tr>
<td>Team Wave (Teledata+Telepresence)</td>
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<tr>
<td>Video conferencing tools</td>
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</table>

If you use another communication tool, please describe and rate it using the scale from the above question  __________________________________________________________
9. In my experience, this model from the following list provides good support to perform Distributed Requirements Negotiation activities with clients / suppliers. *
The Model used to perform Distributed requirements negotiations activities. 
*Mark only one oval per row.

<table>
<thead>
<tr>
<th>Model</th>
<th>Completely agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Completely disagree</th>
<th>Did not use it</th>
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</thead>
<tbody>
<tr>
<td>Arena II (ASP.net Tool)</td>
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<tr>
<td>Arena M (Mobile interface tool works on ASP.Net)</td>
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</table>

If you use another model, please describe and rate it using the scale from the above question

10. In my experience, the following factors affects the Distributed Requirements Negotiation activities *
*Mark only one oval per row.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Completely agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Completely disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geographical distances</td>
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<tr>
<td>Time differences</td>
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<tr>
<td>Cultural differences</td>
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<td>Language differences</td>
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<td>Communication medium</td>
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<tr>
<td>Communication setup cost</td>
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<tr>
<td>Level of domain knowledge</td>
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<tr>
<td>Common understanding of requirements</td>
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<tr>
<td>Trust factor</td>
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</table>

If you have any other affecting factors, please describe and rate using the scale from above question ________________________________________________________________________________.
Conflicts arise when team members reside at different places and lacks in common understanding on the requirements, and this may lead to inconsistencies/ambiguities in the specification. In order to avoid these ambiguities Conflict Resolution activities are considered.

**11. Do you perform Conflict Resolution activities with clients / suppliers in Distributed Environment?** *

Familiarity with distributed Conflict Resolution activities in Distributed Environment

*Mark only one oval.*

- Yes, *Skip to question 8.*
- No *Skip to question 29.*
- Other: *Skip to question 8.*

**12. In my experience, preparatory activities with following interaction medium supports effective Conflict Resolutions with clients / suppliers in Distributed Environment.** *

Preparatory activities can be interaction with suppliers prior to actual Conflict Resolutions meetings; An activity is effective if it leads to the targeted goal.

*Mark only one oval per row.*

<table>
<thead>
<tr>
<th>Interaction Medium</th>
<th>Completely agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Completely disagree</th>
<th>Did not use it</th>
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</thead>
<tbody>
<tr>
<td>Face to face (collocated) interactions</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>Video conferencing interactions</td>
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<tr>
<td>Asynchronous interactions through email</td>
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</tbody>
</table>

If you use another Interaction medium, please describe and rate it using the scale from the above question. ____________________________________________
13. In my experience, this communication tool from following list provides effective support to perform Conflict Resolution activities with clients / suppliers in Distributed Environment. * 
Tools that provides good Communication support for Conflict Resolution activities in Distributed environment; Effectiveness can be "An activity is effective if it leads to the targeted goal".
Mark only one oval per row.

<table>
<thead>
<tr>
<th>Communication tool</th>
<th>Completely agree</th>
<th>Agree</th>
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If you use another Communication tool, please describe and rate it using the scale from the above question. ______________________________________________________________.

14. In my experience, the following factors affects the Conflict Resolution activities in Distributed Environment? * 
Mark only one oval per row.

<table>
<thead>
<tr>
<th>Factor</th>
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If you use another Interaction medium, please describe and rate it using the scale from the above question. __________________________________________________________.