

Success Factors during Requirements Implementation in Global Software Development: A Systematic Literature Review

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ABSTRACT

Requirements implementation is difficult phase of software engineering. In Global Software Development (GSD), it becomes more difficult. There is need to address success factors during Requirement Engineering (RE) in context of GSD. Through Systematic Literature Review (SLR) success factors are identified and then analyzed in this research work. The identified factors are analyzed using different research methods such as case study, interview, questionnaire, surveys, and experiments. The identified factors are analyzed in different sub continents, software company size and period of time. The results of SLR will help vendors to better implement requirements.

Keywords: *Global Software Development; Requirement Engineering; Systematic Literature Review.*

1. INTRODUCTION

During RE, requirements for software systems are collected from clients [1][2][3][4]. Requirement elicitation is the first phase of RE, requirement analysis is second while requirement specification is the third phase and verification is last phase of RE. During elicitation phase, requirements are collected from users while in analyses phase the requirements are analyzed using models from different perspectives for further purification [2][5][6]. In verification phase, requirements are tested. If the cause of an error or failure of software is traced back to RE then it becomes very much costly and difficult to fix errors [7][8]. GSD is development of software product across the globe where vendors and clients are far away from one another. Due to advances in web technology and low labor cost especially in Asian countries, GSD bears a lot of importance. In GSD, requirements collection face a lot of problems like improper communication, culture issues, time zone and language barriers [9][10]. Due to the stated challenges coordination in GSD is difficult [9]. Critical success factors like using collaborative tools and

technologies, proper negotiation and other success factors are discussed by some authors[11]. Identification of these success factors along with analysis is necessary. There is no SLR yet conducted to identify success factors during RE in GSD. Such study will help vendor's organizations to better implement requirements. To achieve the objectives, following research questions are finalized:

RQ1. What are the critical success factors, as discussed in the literature, elaborated from software vendor's view in implementing requirements engineering processes throughout organizations in context of GSD?

RQ2. What is the impact of methodology of research on success factors?

RQ3. Are we found any variation in success factors in different time period?

RQ4. Are the identified factors are affected by changing size of software industry?

RQ5. What is the effect of the identified success factors in different sub continents and countries?

2. BACKGROUND STUDY AND MOTIVATION

According to Wesley James Lloyd [2] collaboration is a success factor and for more collaboration frequent meetings with customers is necessary during elicitation. The author have explained the effectiveness of elicitation techniques using a case study. The vendors can either communicate synchronously like through video chat or asynchronous like emails. According to the author, synchronous way of communication is better than asynchronous as this way of communication brings two parties on direct communication.

Catherine Lowry CAMPBELL [12] discuss the importance of discussing requirements with stakeholders. Proper negotiations require skillful and trained persons. The main advantage of discussion is to remove conflicts from requirements and to reach a consensus. The author have explained four principles for effective and proper discussion i.e. Separate the people from problems, concentrate on importance and activity rather than



positions, make assumptions on conflicts as much possible, and negotiations should have specific aim and purpose.

Yvonne Hsieh [13] focus on knowledge sharing. The author says that knowledge about requirements should not be treated as static but should be transfer to other people. Practice is must along with theoretical knowledge as practice helps to gain knowledge. Collective knowing can increasing collaboration in GSD.

Daniela Damian [14] discuss about the importance and usage of innovative and modern tools , processes and technologies. Modern collaborative tools help to better manage the requirements in GSD. Organizational environment is also necessary for effective communication. When communicating with others, clear roles and responsibilities should be assigned. Several authors have discussed about the role of a technologies like semantic web and ontologies for managing and prioritizing requirements to remove inconsistencies in requirements, handle missing and incorrect requirements, and communication issues [15][16].

Arif Ali Khan [17] says that changes in requirements are difficult to manage in GSD so there is need of requirement change management (RCM) frameworks for handling changes. Any communication risk in RCM will be manage through proper steps. Initiation phase is the first step where request for change comes from user side. Assessment of changes in requirements will be done in evaluation phase and steps will be taken in decision phase for changes.

Daniela E. Damian[14] discuss the negative impact of culture differences on requirements gathering. For minimizing the effect of culture issues the author proposed a model. The model will suggest the practices needed for minimizing the problems and challenges during effective communication between two parties.

According to Gabriela N. Aranda training sessions in must for those who are involve in GSD. It is necessary to give training to professionals during elicitation in GSD for developing skills [11]. Proper risk management should be implemented for handling threatens during RE [18].

Anne Hoffmann [19] discuss the importance of effective global project management. Proper team formation, assignment of roles and responsibilities, bringing collaboration, coordination is the key role of management and all the management activities have impact on RE [20]. Many authors have conducted surveys and SLR but there domain and objectives are different or limited.

3. RESEARCH METHOD

Systematic literature review (SLR) is chosen as research methodology for achieving objectives and goals.

3.1 Systematic Literature Review (SLR)

According to Kitchenham [21] SLR process consist of three main phases.

- Make a strategy for review
- Conduction of the review
- Documentation of review process.

3.2 SLR Protocol

SLR protocol was made before conducting review. Procedures and review plan is specified in SLR protocol. The SLR process contains the following:

- Research questions
- Searching string
- Inclusion and exclusion criteria
- Filling form for extracted data

3.3 Making of Search Terms

For making search terms the following information's are needed

People: Vendors and Clients involved in GSD.

Interference: Success elements of requirement implementation.

Outcome: Better fulfillment of RE in GSD.

Our research question contains the following information. RQ1. [What are the success factors, as discussed in the literature] “Interference”, elaborated from software vendor’s view in [implementing requirements engineering] “Outcome” processes throughout organizations in context [GSD] “People”. ?

3.4 Searching Strategy

It contains the following:

- Searching Range (time and space)
- Methodology
- Sources from where data is collected
- Searching string
- validation of results after searching
- Documenting results

3.4.1 Range of search (time and space)

There is no bound on time period. All the published papers relevant to our research questions will be included.

3.4.2 Method for searching

Automatic and manual search are the two searching methods. In automatic searching, search string is made for different digital libraries and executed accordingly while in manual searching we search a paper without making a proper search string just by writing paper title.



3.4.3. Data sources used:

- IEEE Xplore
- Science Direct
- Acm portal
- Springer link

3.4.4 Search Strings

A. Beginning search string: This is initial made search string helps in making big search string.

B. Big search string: Combining major terms of research questions we can make a big search string.

C. Smaller sub search string: Big search string needs to be divided into smaller sub strings because many libraries do not accept big search strings.

Strategy for searching used is discussed below.

Step1: From research questions we will identify major terms use for searching.

Step2: Find the synonyms for every major term.

Step3: Using Boolean Operators for combining of major terms. For combining major terms “AND” operator will be used while for combining substitutes “OR” operator will be used.

Result of Step1: “Requirement Engineering”, “Global software development”.

Results for 2:

“Requirement Engineering”: ((“Requirement engineering” OR “requirement elicitation” OR “requirement analysis” OR “requirement specification” OR “requirement gathering” OR “requirement management” OR “requirements”)

“Global Software Development”: (“Global software development” OR “GSD” OR “distributed software development” OR “international Software Development” OR “multisite software development” OR “offshoring”)

Results for 4: ((“Requirement elicitation” OR “Requirement engineering” OR “requirement analysis” OR “requirement specification” OR “requirement gathering”) AND (“Global software development” OR “GSD” OR “distributed software development” OR “international software development” OR “multisite software development” OR “offshoring”)))

3.4.5 Documenting results of the search:

Documentation of search include the following:

- Digital library name
- Total publications found
- Total publications selected
- Initial chosen papers
- Final chosen papers

3.6 Selection of Publication

Publication selection process contains the following steps.

- Inclusion Criteria
- Exclusion Criteria
- Publication Quality

3.6.1 Inclusion Criteria

Inclusion criteria should be define for final selection after retrieving papers. The following points are included in inclusion criteria:

- Only those papers will be selected which are written in English
- Papers which discuss only RE in the context of GSD.
- Papers related to GSD but discussing requirement collection or papers related to RE but some factors can also be fitted in context of GSD.

3.6.2 Exclusion criteria

The criteria of excluding papers from final list is given below:

- Studies which are not according to Research questions.
- Studies not discussing RE factors in GSD.
- Studies conducting in GSD but RE is not written in title of the paper.

3.6.3 Selecting primary sources

Table 1 shows data sources, total count of papers and final selected papers:

Table 1: Data sources and search strategy

resource	Total publications	Initial selection	Final selection
IEEE explore	1140	60	42
ACM	1204	15	8
Science Direct	2730	23	9
Springer Link	508	18	06
Others	2502	55	27
Total	8064	171	92

3.6.4 Publication Quality Assessment

Quality is checked in parallel with data extraction from papers. The quality checklist contains the following questions:

- Is the paper discuss the success factors relevant to RE in GSD or not?



- Has there sufficient data/sample size to support the findings?

3.7 Strategy of Data Extraction

Data extraction process consists of the following phases.

3.7.1 Primary Study Data: Following information’s are needed for data after extraction from publications.

- Detail of publication(Title, Authors, Reference)
- Data related to research questions.

3.7.2 Data Extraction Process: Data extraction process needs careful reading of whole paper so that all necessary information’s and factors can be dig out. Secondary reviewer can help us for reviewing the data so that we can confirm that our findings are correct.

3.7.3 Data synthesis

The extracted data (Cfs) will include the following information’s.

- Date of review
- Details of the publication (Title, Authors, Reference)
- Software company or industry size
- Region of the Analysis (continent)
- Year of publication

4. RESULTS

A. Success factors identified through systematic literature Review

For answering RQ1, Table 2 shows list of identified success factors through SLR. The frequency of each factor is also given in the table. If the frequency of factor increases then it means its importance increases and becomes critical. Factor having frequency above then 50% are said to be critical. Other authors in their studies also used the same criteria [22].

Table 2: Success factors identified through SLR (in descending order of Frequency)

S.NO	Success factors	Freq N=92	%	Sources (List given at the Appendix)
1	Effective and strong communication system	74	81%	1,2,3,4,5,6,7,8,9,10,11,13,14,16,18,19,20,21,22,23,24,26,28,30,31,33,34,37,38,39,40,41,42,43,44,45,46,47,48,51,52,53,54,55,56,57,58,59,60,61,62,63,64,65,67,68,69,70,71,72,75,76,77,79,80,81,84,85,86,87,88,89,91,92
2	3C (coordination, cooperation and collaboration)	62	68%	1,2,3,4,5,7,8,9,10,11,14,16,18,19,20,21,23,26,35,36,37,38,39,40,41,43,44,46,47,48,49,50,51,52,53,54,55,56,57,58,60,62,63,67,69,70,71,72,73,76,77,78,79,80,81,83,84,85,86,87,81,91
3	Using collaborative tools	53	58%	1,2,5,6,7,8,10,14,15,16,19,22,25,27,28,29,31,34,35,37,38,39,40,41,42,43,46,47,48,50,52,55,57,58,59,60,61,63,66,67,68,69,71,77,79,82,83,86,87,88,89,90,91,
4	Knowledge Management and sharing	49	53%	3,4,6,10,11,14,16,18,19,20,21,22,24,25,28,29,33,41,43,45,46,49,50,53,55,56,57,58,60,62,65,66,67,69,70,71,72,73,76,79,80,82,84,85,86,88,89,91,92
5	Effective management	47	51%	4,6,10,11,12,18,19,21,22,23,25,27,28,29,32,37,41,42,43,45,46,47,48,51,53,54,55,57,58,59,62,63,66,68,70,75,77,78,83,85,86,87,88,89,90,91,92
6	RE modelling	46	50%	3,4,5,9,12,14,15,17,18,24,26,27,28,29,30,33,35,36,38,39,40,44,47,48,50,52,53,60,63,64,65,66,67,71,72,73,74,75,76,81,82,83,86,89,90,92
7	Proper discussion on requirements	41	45%	1,2,7,9,11,12,14,15,21,22,23,24,26,29,30,32,38,40,44,48,50,52,55,56,57,60,61,62,64,66,67,69,70,72,76,77,78,79,84,89,91
8	Software engineering process maturity	35	38%	2,4,15,19,20,22,25,27,31,32,33,36,39,44,45,47,50,51,53,55,57,58,64,68,72,73,74,77,80,83,85,86,89,90,92
9	Mutual Trust	28	30%	2,3,4,7,8,9,11,14,20,23,24,31,32,39,45,47,50,57,63,67,68,69,75,76,78,79,87,91,
10	Requirement change management	27	30%	8,13,14,15,16,17,26,30,33,38,39,41,44,45,50,52,53,56,59,66,75,81,82,83,86,89,90,
11	Training sessions	23	25%	9,11,19,20,22,25,28,32,40,41,43,46,49,57,58,65,67,77,78,85,87,89,91
12	Organizational proximity	16	17%	11,18,21,22,28,32,34,50,53,54,57,63,65,69,78,91
13	Use of new technologies	22	24%	4,6,7,16,18,22,28,33,34,36,37,38,39,53,56,59,69,71,73,77,78,82
14	Social networking	1	1%	9
15	Infrastructure and organizational setup	4	5%	19,20,25,39



'Effective communication' (81%) is the most critical factor found from literature. Communication can either be synchronous like video chats or asynchronous like emails etc.[12].

'3C (coordination, cooperation and collaboration)' (67%) is also identified as critical factor in GSD.

'Using collaborative tools' (58%) is identified as critical factor. Practitioners have suggested dozens of tools for GSD in order to communicate properly[23][24].

'Knowledge Management and sharing' (53%) is important factor found in literature. Updated and accurate knowledge is needed about what is going across globe. Organizational structure and environment is important for knowledge sharing[25]. Shared knowledge of requirements is also necessary for effective RE implementation.

RE modeling (50%) is an important factor discussed by authors in literature. Using models can help in better understanding the requirements and different authors have presented models in GSD for better RE implementation [26].

'Proper discussion of requirements' (45%) is important factor identified from literature. One of the big advantage of discussion on requirements is resolution of conflicts about requirements[2][12]. Discussing requirements can bring collaboration between clients and vendors.

Process maturity is identified as important success factor (35%) in GSD. Similarly process maturity is important in case where requirements are changing frequently like agile process model can help much in GSD[27]. Infrastructure improvements are also needed because it can increase coordination, communication and share understanding of requirements[25].

Trust is important factor in GSD (30%). According to Anne Hoffmann team formation in GSD is very difficult and trust plays important role in team formation. Increasing collaboration between team members is the key factor for building trust[19].

Requirement change management activities (30%) are necessary for handling changes from users. Different authors have presented frameworks and models to manage changes during RE [17].

Arranging training sessions for GSD stakeholders and RE team is important. Training on using modern tools and advance technologies is also very important.

B. Analysis of success factors on different research methods used

Table 3 shows the results for RQ2 based on the study strategies used. The papers are grouped on the basis of research methods used, i.e. case studies(CS), interviews(I), surveys(S), literature reviews (LR), systematic literature reviews (SLR), experience report (ER), thesis (T), experimental study (ES) and other (other

than listed). Different CSFs have been identified with different percentage in different study strategies, for example. From the results we found that 'Effective and strong communication' and 'coordination and collaboration' are the most critical success factors found through all methods of research.

- 'Using collaborative tools' is critical factor found through case study (60%), interview (54%), and survey (50%), experience report (67%) and experimental (72%).
- 'Knowledge Management and sharing' is the most critical success factor found through case study (50%), Survey (50%), SLR (80%), literature review (57%) and experimental study (55%).
- 'Effective management' is the critical factor found through case study (50%), SLR (60%), literature review (72%) and experience report (100%).
- 'RE modelling' is the critical factor found through interview (77%), survey (75%), and experimental study (64%).
- 'Proper discussion on requirements' is the critical factor found through case study (59%), survey (50%).
- 'Infrastructure and organizational setup' is the critical factor found through SLR (60%), literature review (57%), and experience report (67%).
- 'Requirement change management' is the critical factor found through survey only (63%).

We found significance difference in factor 'Use of new technologies'. The methods through which this factor was identified were case studies and experiments. Because new and modern technology should be evaluated first through experiments and most of the authors who mentioned this factor belongs to industry and through case studies and experiments they tested the technology. Most of new technologies presented here are semantic web and ontology and it can be presented better through experiments or it can be explained after some experience.

C. Analysis of success factors in different decades or period of time

In order to give answer of research RQ3, table 4 shows a list of success factors in different periods.

As we seen all papers are published in period of 2000 onward and we have categorized papers into two periods of 7 years each i.e. 2000 to 2006 and 2007 to 2014. Out of 92, 27 papers are published in period from 2000 to 2007 and 65 are published in period above 2007 which shows



that much work in this area is done in recent areas while 1% work we found below 2000.

Table 3: Distribution of Success factors on research methodology

Factors	Occurrence in SLR (n=92)									Chi-square Test (Linear-by-Linear Association) $\alpha = .05$	
	Study strategy									X ²	p
	Case Study (N=32) %	Interview (n=13) %	Survey (n=8) %	SLR (N=5) %	Literature Review (n=7) %	Experience Report (N=3) %	Questions (n=1) %	Experimental Study N=22 %	Other N=1 %		
Effective and strong communication system	88%	85%	63%	100%	71%	100%	100%	68%	100%	1.918	0.166
3C (coordination, cooperation and collaboration)	78%	46%	50%	80%	57%	67%	100%	68%	100%	0.004	0.948
Using collaborative tools	60%	54%	50%	20%	29%	67%	100%	72%	0%	1.076	0.300
Knowledge Management and sharing	50%	46%	50%	80%	57%	33%	100%	55%	100%	0.448	0.503
Effective management	50%	62%	38%	60%	72%	100%	100%	32%	100%	0.455	0.500
RE modelling	31%	77%	75%	40%	43%	33%	0%	64%	0%	1.270	0.260
Proper discussion on requirements	59%	38%	50%	40%	14%	33%	0%	36%	100%	2.506	0.113
Software engineering process maturity	22%	39%	25%	60%	43%	67%	100%	36%	0%	1.529	0.216
Mutual Trust	47%	31%	13%	0%	29%	34%	0%	18%	100%	3.192	0.074
Requirement change management	22%	15%	63%	40%	0%	33%	0%	46%	0%	2.103	0.147
Training sessions	28%	8%	13%	20%	29%	33%	100%	27%	100%	0.892	0.345
Organizational proximity	25%	15%	13%	0%	0%	0%	0%	18%	100%	0.174	0.677
Use of new technologies	22%	0%	0%	20%	0%	100%	0%	50%	0%	8.410	0.004
Social networking	3%	0%	0%	0%	0%	0%	0%	0%	0%	0.945	0.331
Infrastructure and organizational setup	6%	0%	0%	0%	14%	0%	0%	5%	0%	0%	0.988

- ‘Effective and strong communication system’, ‘3C coordination, cooperation and collaboration’, ‘Using collaborative tools’, ‘RE modelling’ are the critical success factors found in both periods.
- ‘Knowledge Management and sharing (57%)’, ‘effective management (55%)’ are the critical success factors found in period below 2007 while Proper discussion on requirements (59%), Mutual Trust (48%) are critical factors found above 2007 period.
- We have noticed only one significant difference in factor ‘mutual trust’. In the recent period of time trust factor is increased because in the recent decade we can note much advances in modern tools and

technologies so collaboration and trust is increased. The percentage occurrence of new technologies is

14% in period of 2000 to 2006 and 28% in period of 2007 to 2015.

D. Analysis of factors in different software company sizes

In order to address RQ4, Table 5 shows a list of success factors in different company sizes.

We have categorized our work in three company sizes, small (Employee < 20), medium (employee less than 200), Large (Employee > 200).



- ‘Effective and strong communication system’, ‘(Coordination, cooperation and collaboration)’ and ‘Using collaborative tools’ are critical success factors (>50%) found in any company size and

which shows that these factors are equally important for all type of type of organizations.

Table 4: Analysis of success factors in two periods

Factors	Chi-square Test (Linear-by-Linear Association)					
	$\alpha = .05$					
	2000-2006 N=27		2007-15 N=65		χ^2	P
Freq	%	Freq	%			
Effective and strong communication system	21	78	53	82	0.170	.680
3C (coordination, cooperation and collaboration)	18	67	44	68	0.009	.924
Using collaborative tools	17	63	36	55	0.444	.505
Knowledge Management and sharing	12	44	37	57	1.180	.277
Effective management	11	41	36	55	1.619	.203
RE modelling	14	52	32	49	0.052	.820
Proper discussion on requirements	16	59	25	38	3.304	.069
Software engineering process maturity	7	26	24	37	1.021	0.312
Mutual Trust	13	48	15	23	5.602	.018
Requirement change management	9	33	18	28	0.290	.590
Training sessions	7	26	16	25	0.017	.895
Organizational proximity	5	19	11	17	0.033	.855
Use of new technologies	4	14	18	28	1.720	.190
Social networking	1	3.7	0	0	2.407	.121
Infrastructure and organizational setup	1	4	3	5	0.038	0.846

- ‘Knowledge Management and sharing’ is critical success factor found in large size (58%) and medium size software Company (56%). In small organizations this factor is found (25%) only.
- Effective management is critical factor (54%) found for large company size only as large company size software houses have big teams and a lot of projects, so the need of effective management become increases.
- ‘Proper discussion on requirements’ is critical factor for medium (56%) and large (54%). As large size software’s have complexities and much issues as compare to small projects so it needs proper negotiation to resolve them.
- ‘Process maturity (50%) is more critical for small organizations as in small organizations there is lack of process maturity as compared to big organizations so this challenge is focused.

- ‘Requirement change management is the most cited factor in large organizations (50%) only.
- “Using new and modern technology” (50%) is critical factor found for small organizations. We argue that large organizations have resources and they can implement new technologies but small organizations normally do not implement modern technologies.

E. Analysis of success factors in different sub continents

In order to give answer of research RQ5, Table 6 shows a list of success factors in different sub-continent.

We have divided our work in four continents i.e. Asia, Europe, Australia, America and mix of all continents as paper retrieved through SLR were from these continents. From the result we found that ‘Effective and strong communication system’ and ‘3C (coordination,



cooperation and collaboration) are the most critical success factors in all sub continents.

- ‘Using collaborative tools’ is most critical factor found in Asia (54%), Europe (69%), America (58%) and Mix (50%) of countries.

Table 5: Distribution of success factors based on company size

factors	Small (N=8)		Medium (N=16)		Large (N=24)		X ²	p
	Freq	%	Freq	%	Freq	%		
Effective and strong communication system	6	75	13	81	20	83	1.211	0.271
3C (coordination, cooperation and collaboration)	5	63	11	69	20	83	0.629	0.428
Using collaborative tools	6	75	10	63	15	63	0.137	0.712
Knowledge Management and sharing	2	25	9	56	14	58	0.379	0.538
Effective management	4	50	6	38	13	54	0.200	0.655
RE modelling	3	38	6	38	10	42	0.249	0.618
Proper discussion on requirements	3	38	9	56	13	54	0.000	1
Software engineering process maturity	4	50	5	31	5	21	2.692	0.101
Mutual Trust	3	38	7	44	9	38	0.570	0.450
Requirement change management	2	25	4	25	6	25	0.582	0.445
Training sessions	2	25	5	31	8	33	0.373	0.542
Organizational proximity	1	13	3	19	7	29	0.433	0.511
Use of new technologies	4	50	5	31	7	29	0.040	.841
Social networking	0	0	1	6	0	0	0.350	0.554
Infrastructure and organizational setup	1	13	1	6	1	4	1.091	0.296

- Knowledge Management and sharing’ is critical success factor found in Europe (55%), America (67%), Australia (60%) and Mix (55%).
- ‘Project management’ is the most critical success factor found in Europe (55%), Australia (60%) and Mix (60%).
- ‘RE modelling’ is the critical factor found in Asia (69%), Europe (52%) and America (58%).
- ‘Proper discussion on requirements’ is most success factor in America (67%), Australia (80%) and Mix (50%).
- ‘Process maturity’ is critical factor in Asia (50%).
- ‘Requirement change management’ is critical factor found in Asia (50%).

We see significance difference in three factors “RE modelling, “Requirement change management”, “Proper discussion on requirements” and “process maturity”. The frequency of ‘RE modelling’ is low in mix (20%) while it is high in Asia (69%), Europe (52%) and America (58%). we argue that as in Mix continents the countries belong to different countries so other factors like ‘Effective and communication’, ‘3C (coordination, cooperation and collaboration)’. We found significant difference in factor

Proper discussing requirements. It is low in Asia (31%) and Europe (38%) while it is high in Australia (80%), America (67%) and Mix (50%). There can be many reasons for this because in mix continents, America and Australia due to geographical distance and other challenges like culture difference, language difference proper discussion on requirements become necessary. While this problem is less in Asia countries as there exist less culture differences and time differences. The studies in asia are mostly done in same city. We found another significant difference in factors ‘Requirement change management’ and ‘process maturity’. The frequency of these factors is low in America, Australia, Mix, and Europe and high in Asia because the labor cost is less in Asia (India, China, and Pakistan) so mostly Asian countries play the role of vendor in GSD and any change from user in requirements need change management activities so the authors of Asia have highlighted this factor more. We found significant differences in those factors which are related to requirement management and this factor is high in Asia as compare to other continents.



5. LIMITATIONS OF THE CURRENT WORK

How correct are our results? One possible threat to internal validity is that the reason and causes for success factor might not be explained in some papers. It was also possible in some studies to report other success factors.

Table 6: Distribution of success factors across 3 continents as identified in the SLR

Factors	Occurrence in SLR (n=92)										Chi-square Test (Linear-by-Linear Association)		
	Asia (N=26)		Europe (N=29)		America (N=12)		AUSTRALIA (N=5)		Mixed (N=20)		χ^2	df	p
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%			
Effective and strong communication system	20	77	20	69	11	92	4	80	19	95	2.795	1	.095
3C (coordination, cooperation and collaboration)	16	62	18	62	10	83	3	60	15	75	.897	1	.344
Using collaborative tools	14	54	20	69	7	58	2	40	10	50	.597	1	.440
Knowledge Management and sharing	11	42	16	55	8	67	3	60	11	55	1.043	1	0.307
Effective management	12	46	16	55	4	33	3	60	12	60	.450	1	.503
RE modelling	18	69	15	52	7	58	2	40	4	20	8.372	1	.004
Proper discussion on requirements	8	31	11	38	8	67	4	80	10	50	5.214	1	.022
Software engineering process maturity	13	50	9	31	4	33	1	20	4	30	4.270	1	0.039
Mutual Trust	6	23	7	24	5	42	1	20	9	45	1.826	1	0.177
Requirement change management	13	50	8	28	1	8	1	20	4	20	5.598	1	.018
Training sessions	7	27	8	28	2	17	1	20	5	25	.185	1	.668
Organizational proximity	5	19	6	21	0	0	1	20	4	20	.061	1	.805
Use of new technologies	6	23	9	31	3	25	1	20	3	15	0.544	1	.461
Social networking	0	0	1	3	0	0	0	0	0	0	.126	1	.722
Infrastructure and organizational setup	2	7.7	5	17	3	25	1	20	2	10	0.274	1	0.601
Effective and strong communication system	1	4	1	4	0	0	0	0	2	10	0.244		0.622

Many of the contributing studies were self-reported experience reports, case studies and empirical studies which may be subject to attribution, reporting or publication bias. The methodologies were not clearly defined in some papers and most of the methodologies through which we identified our factors were mostly self-reported experience reports, SLR or literature reviews. Only 3 authors have used experimental methodology. During the selection of primary studies and data extraction we have performed the inter-rater reliability tests in order to reduce the researcher's bias. However, it was not possible to check each and every paper by the

secondary reviewer. For checking the correctness or verifying the critical factor these identified factors should be validated through questionnaire survey from software industry. Through survey it will be also possible for us to identify some new factors also which can contribute to the knowledge of researchers.

6. CONCLUSION AND FUTURE WORK

We have found all those factors which have positive impact during RE in GSD. We did analysis of the



identified factors in different continents, company size, period of time and experimental methodologies. In future we aim to provide a list of critical challenges along with practices and solutions. Our future work include industrial evaluation of these factors along with finding some new factors too. Survey will also help to identify some new practices from industries side. Final goal is to develop requirement implementation model (RIM) and the current work will be the first step of RIM. The idea and detail framework of RIM is published in IEEE conference [1].

ACKNOWLEDGMENTS

We are thankful to the autonomous reviewers of the paper and their valuable comments in general and for validation of CSFs in particular. We are also thankful to those who appreciated our work and increased our confidence level.

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APPENDIX: LIST OF FINALLY SELECTED PAPERS

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