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Motivators for Large-Scale Agile Adoption From Management Perspective: A Systematic Literature Review

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ABSTRACT The use of agile methods for software development has grown to a large extent in the last few years. These methods ensure the quick delivery of software products with minimal cost and user satisfaction. Though these techniques were initially developed for small developmental teams, certain challenges have been observed when these methods are applied on large scale. However, we have conducted a systematic literature review (SLR) for the identification of motivators for adopting agile methods on a large scale from a management perspective. Thus, we have identified a total of 21 motivators for adopting agile methods on a large scale from a management perspective. Among these motivators, some were marked as critical motivators depending on variables, e.g., the factors critical in one variable might not be critical in another variable. The factors which were recorded as critical in all variables are strong executive support, agile development environment training and learning, agile development expertise, team competency, and briefing of top management on agile. Furthermore, we also found that the impact of different motivators was different depending on time and place for project manager guidance, i.e., some motivators were most critical in one region while less critical in another. Similarly, some of the motivators were more critical in previous decades but less critical in recent decades because of different improvements in software processes and technologies. These motivators are also analyzed from different angles, i.e., decade-wise and region wise for project managers guidance. The motivators are extracted from a sample of 58 research papers identified via an SLR process. Finally, we have analyzed the identified motivators based on various variables, such as continents and digital libraries.

INDEX TERMS Large-scale agile, agile software development, systematic literature review, adopting agile methodology, success factors.

I. INTRODUCTION

Agile methods were meant for practice in single or small development teams and projects [1]. However, due to its usefulness, these methods can be applied in Large-Scale Agile Development (LSAD) teams and projects as well. Adopting Agile methods in larger projects and teams [2], is difficult as compared to smaller ones -which is the first choice- larger ones will need more coordination. LSAD teams and projects require the involvement of other organizational units like marketing, Human Resources (HR), and product management. In spite of these obvious problems related to LSAD teams and projects, there is an increasing tendency towards adopting them [3]–[5].

A thorough literature search established previous explanations of what large-scale agile is (Dingsoyr, Itkonen, & Faegri, 2014). Size has been measured in the size of persons or teams, size of code, project budget, and project incantation. According to [6], a project consisted of seven development teams and 40 people will be termed as a large-scale project.

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While [7] argue that a project which cost over 10 million GBP and a team size of 50 persons will be termed as a large-scale project. Additionally, [8] suggest that project having over 5 million lines of code will be called as a large scale project. In point of view of [9], a project spell of 2 years with a project range of 60-80 traits/characteristics should be considered as a large-scale project. Grounded on the findings of [10], we can measure project size by the number of coordinating and collaborating teams. According to them a project having 2-9 collaborating teams will be called large-scale project while a project over ten collaborating teams will be considered very large scale.

Besides the above-mentioned findings of different researchers, we found a number of other studies debating LSAD teams and projects as well. Most of these argued on the number of persons take part in the project. In the initial literature on Agile (Fowler, 2000) believe that the crystal methodology is suitable for up to 50 persons. The same number has been stated by other researchers as a measurement of the size of the firms candidate for using Agile Software Development Methods (ASDM) [11]. Furthermore, other researchers like (Koehnemann & Coats, 2009) have mentioned agile projects including up to 50 persons as small, and project ranging from 50 to 100 persons as large [12].

Participants of the XP2014 on large-scale agile workshop provided different definitions for LSAD team [3]. According to the participants, what is to be considered as large-scale depends largely on the person defining it and on the context. Based on the previous literature findings, we will define large-scale to represent Software Development Organizations (SDOs) having 50 or more employees or having at least six development teams. Moreover, all employees are not necessary to be developers but it is important to belong to the same SDO. Additionally, they will be working on a common project or developing a common product, and thus have a need to collaborate. For instance, software architects and scrum masters are the available tools for assessing the organization size.

Additionally, agile methods also touch business and management related functions. A crucial challenge is that an organization must move towards the iterative and feature-centric model. They must move away from life-cycle models [13], which requires a change in attitude. The emphasis has to be adopted from enduring organization level planning to short-term project level planning [14]. Agile methods urge that planning is only useful for the near future [15]. However, the lack of planning and be a matter of worry, because corporate customer relationships often cultivate on following long-lasting organizational plan. Synthesizing operation with short-term planning needs socializing investors and analyzing the process of contracting [16].

II. LITERATURE REVIEW

The state of the agile survey has been organized since 2007 which was version one [17]. It has lately asked a couple of questions associated with large-scale development teams i.e. scaling techniques used, and guidelines for improvement of Agile methods for large development teams. As stated by the most up to date survey [17], [18], out 4000 participants 62% participants state that they had more than 100 persons in their software houses, and 43% of participants have stated that more than 50% their team consists of agile experts. Certainly, the participants of this research were minimized to a selected smaller team of companies. Out of four thousand participants in the survey, 65% belongs to Northern America and only 26% were from Europe. Nevertheless, this shows that there appears to survive a large number of software companies that have adopted or aims to adopt Agile methods into practice in a large-scale environment [17].

Agile Software Developments method (ASDM) is the aggregate of incremental software engineering techniques which are supported on an ''Agile Philosophy'' snapped in the ''Agile Manifesto'' [19]. Even though mostly recollecting olden reputable software development practices, the agile methodology is able to be viewed as a substitute for the ''traditional software development methodologies''. While a traditional approach and methodology emphasize on straightforward planning and rigorous management of modification, ASDM were designed to confess, and sharply manage modification [19], [20]. ASDM have been both condemned and supported. Research has manifested that accepting change may be a part of failure and success [16]. It has been brought to light that agile approaches have increased trust of both clients and vendor. But, on the other side, there is a proof that ASDM might not be best for larger projects and teams [2]. Therefore, a solution at hand is that each group looks for its balance of ASDM [16].

Most common agile approaches are; Scrum and Extreme Programming (XP) [21]. The problem of presenting ASDM enhances with the development team size [22]. The problem is partially connected with size creating huge lack of activity in an organization which weakens managerial change [23]. ASDM are not constructed for the use of specific tools or trials, but reasonably on the basis of general and common approach. adopting ASDM, time and again need modification of the whole organizational structure [14]. A noticeable rift between large-scale and small-scale adoption is that large firms have more reliance on teams and project. This elevates the need for strict documentation and hence weakens swiftness and dynamism [24]. Moreover, for coordination between team and development teams have to work together with other non-agile administrative units. For example, HR unit may require and need persons to indicate severely the title role in projects [1], or a change control board may limit the constant use of repackages [24]. All units hit by the change to agility require to be notified and discussed, and the agile process must be made familiar according to their requirements [1], [15], [24].

ASDM also upset business and management related tasks. An essential task in managing organization has to move towards iterative and feature centric models i.e. deviate from life-cycle models [13], which need modification of

approach. The emphasis has to be adopted from long-lasting organization level planning to short-term project level planning [15]. ASDM suggest that planning is only useful for the near future [15]. Nevertheless, the lack of planning could be a matter of worry, because corporate customer relationships often grow on following long lasting organizational plan. Combining operation with short-term planning needs socializing investors and analyzing the process of contracting [1].

While the research literature includes a bunch of experience reports, and some case studies on LSAD adoption from management perspectives, a summary of this growing body of research is still missing in the form of SLR [25]. The industrial practitioners at the XP2010 [26] choose to construct a backlog of topics; they think it should be studied. As the leading hot research question, the practitioners voted agile and large development teams. The research on ASDM is collecting and developing and has created a need for executing SLR [22], [27], [28], the area and premises of LSAD from management perspectives have not yet been explored via secondary studies. In this paper, we aim at filling some of the gap with a hand out the outcome of SLR for LSAD team and projects from management perspectives.

In spite of the importance of ASDM in the background of LSAD from management perspectives, no SLR has been conducted on ASDM for large-scale development from management perspectives in general and on the finding of factors that have a remarkable impact on vendor organizations in specific terms.

III. RESEARCH METHOD

To achieve our expected goals and objectives as an outcome from this research accurately, we have adopted systematic literature reviews (SLR) to gain maximum from existing literature. This research approach has been adopted by other researchers such as [29]. A SLR is a new approach in software research field for identification, assessment and interpretation of all related research for a specific research area, or phenomenon of interest [30]. We had identified critical success factors for adopting ASDM for a large scale development team from management perspectives. The existing literature has been reviewed through SLR.

A. SYSTEMATIC LITERATURE REVIEW (SLR) PROCESS

SLR has three major levels/tiers which are described by [30] and [31] review plan, review execution, and review reporting. In article at hand, we first plan the SLR plan in the form of a protocol which is the starting point of a SLR (i.e., planning).

B. SYSTEMATIC LITERATURE REVIEW (SLR) PROTOCOL DEVELOPMENTS

Prior to carrying out the SLR, we designed a review protocol. It decreases researcher prejudice and enhances the accuracy and review repeatability [29], [30]. Particularly, it outlines context for the exploration, search strategy, exploration questions used to look for the relevant literature, setting criterion for including and excluding material, for choosing relevant readings, the conduction and publicizing quality assessment, the plan for removing data, the plan for synthesizing data, and the methodology for extracting and storing information for addressing the research questions [29], [30]. The steps are illustrated in Fig. 1.

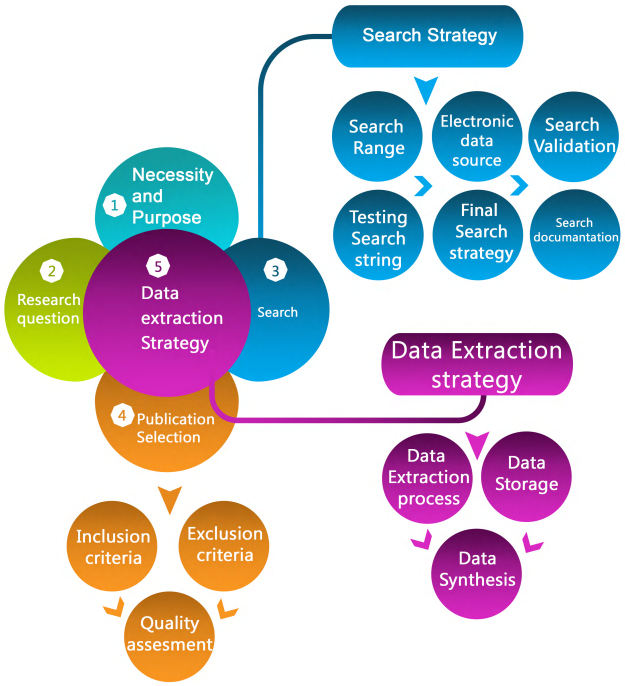

FIGURE 1. Portrays the several tiers in the SLR process.

C. RESEARCH QUESTIONS

In spite of the importance of ASDM in the context of large-scale development from management perspectives, no SLR have been conducted on ASD in general and on the finding of factors that impact on hawker organizations in specific terms. To do so, we aim to focus the below research question:

RQ1. What are critical success factors, as identified in the literature, in adopting agile at large-scale development team from management perspective? RQ2. Do the identified factors show any significant variation from one continent to another continent? RQ3. How are these factors related to the study strategies used? RQ4. How are these factors related to the company size? RQ5. How are these factors related to the search venues? RQ6. Do the identified factors show any significant variation over time?

D. SEARCH STRATEGY & PUBLICATION SELECTION

In conducting the SLR, we used [1] and [2] as our guideline for gaining a comprehensive insight into the existing literature. The literature search was performed for the studies published in academic journals and conference proceedings between the years 2000 and 2016, as made available

FIGURE 2. Publication selection process.

through the digital libraries of (in alphabetical order); ACM, ScienceDirect, Google Scholar, SpringerLink, and IEEE Explore. The numbers of studies initially retrieved and identified from these libraries are given in Table 1. Out of 6867 studies that were retrieved in this way, we identified 367 studies that were deemed relevant for the purpose of this study. Eliminating the duplicate works and narrow down more to our area, we targeted 58 studies for a thorough analysis. We studied the primary sources of publications and reports that introduce the Agile methods and explored the publications that are commonly referred to in this research field. We worked on keywords and terms that these studies use to specify essential concepts of relevance to Agile methods. For the retrieval in the digital libraries, the string given below was derived and taken as a basis, which was applied to the title, keywords, and abstracts of publications: (''Agile methods'' or ''agile software development'' or ''agile methodology or agile system development'') AND (''Large-scale development team ''or ''large-scale development team'' or ''large development team'') AND (Motivators or factors or ''success factors'' or ''positive impact'' or promoters or supporters or key factors).

TABLE 1. Search results.

Resource	Total Results found	Primary selection	Final selection
IEEExplore	36	31	18
ACM	1216	80	6
Science Direct	785	66	8
Google Scholar	3154	120	20
Springer Link	1676	70	6
Total	6867	367	58

We used the research questions and a stepwise strategy to obtain the final search string; the strategy is as follows:

Identify intervention, population, and outcome on the basis of research questions. Identify the main term and construct search term from it. Find the synonyms and alternative spellings for each main term. Validate the terms and synonyms in any related paper. Combine these terms using Boolean OR/AND operators.

Some electronic libraries (such as Web of Science and SpringerLink) do not provide advanced search options that allow for the use of the search string as is. For these sites, we either extended the context of the search (e.g., in Topic in Web of Science) or separated the search into several sub-searches (e.g., in SpringerLink) preserving the initial search context. The following steps were derived from the guidelines for performing SLRs in software engineering [1] and applied as a procedure in systematically searching and selecting the relevant studies:

1. Define the research objective. 2. Conduct several example searches; review the scopes. 3. Define the search string; identify inclusion and exclusion criteria. 4. Conduct an initial search. 5. Review the title, abstract, and keywords of the initially retrieved studies. 6. Revise inclusion and exclusion criteria; select potentially relevant studies. 7. Remove duplicate studies. 8. Review potentially relevant studies selected; discuss any issues. 9. Review the entire content of initially selected studies (including the references section for identifying the studies that are potentially missed); identify relevant ones. 10. Review relevant studies selected; discuss any issues. 11. Identify the final set of relevant studies.

All steps were conducted with the involvement of at least two authors. In selecting the relevant studies in steps 6, 9, and 11 of the search and selection procedure described above, we applied the inclusion criteria as the studies that propose, apply, validate, classify, or thoroughly analyze one or more generic Agile methods. Steps 811 were carried out independently by two authors, and conflicts were resolved after each step. Independent analysis results were documented in spreadsheets, which were then compared and merged by one of the authors. Conflicts were noted for discussion, which was held before the joint authors continued with the subsequent step. The initial number of studies retrieved in step 4 was 6867 and after step 5, we selected 1000 studies out of these for further investigation. We revised the inclusion and exclusion criteria Fig. 2 show this.

The refinement steps in the SLR procedure and resulting number of articles. Working on these studies and at the end of step 6, we came up with 367 studies. We followed the inclusion criteria and papers were selected based upon these points i.e. Paper that is written in the English Language, The article/paper is available in full text, Research papers that are relevant to our research questions, Research work that describes Agile methods from management perspectives, Research work that describes Agile methods using large-scale development team, research papers that describes success or motivators of Agile methods for large scale development team. In step 7 we removed duplicate studies and followed the exclusion criteria i.e. Article/papers/books etc. that do not fulfill inclusion criteria as mentioned above been excluded. Within this set and identified 100 studies for a thorough analysis. In steps 8 and 9, we went over these studies in detail, discussed and resolved conflicts, and identified 67 studies for

TABLE 2. Data extracted.

#	Note	Description
N1	Author(s)	Author(s) of the included studies in the SLR.
N2	Title	Title of the paper included studies in the SLR.
N3	Year	Year in which the study was published?
N4	Venue	Publication category of the included article: For example Conference, Journal, etc.
N5	Research Methodology	A kind of research methodology incorporated in the included article? It can be case study, experience report, etc.
N6	Data Gathering Method(s)	A kind of research tool use for gathering data. For example Interview and questionnaire survey, literature review etc.
N7	Citation count	It is number of citation of the selected study on scholar.google.com.
N8	Study Perspective	The study Perspective is grouped into academic (e.g. student cases) and industry.
N9	Components of Analysis	The basic unit (e.g., organization or a project) that is under investigation in the study.
N10	Company Size	It is the size of organization where the studied project is selected from or the researcher carried out the study.

a deeper review. We had final discussions at steps 10 and 11 for the inclusion of several studies, and reached 60 and finally 58 studies, respectively. All search pages saved as HTML files. The primary data of each search recorded electronically using Google drive form, and the below-mentioned data documented:

Search date Search Phase Name of the database No. of publications found Initial selection decision Final selection decision No of publication selected Search strategy

We checked and assessed the quality of finally selected papers. The assessment describes these points; is the objective of the research is clearly defined? Are the outcomes of the research is connected to the objective of the research? Whether the Agile software development context is discussed clearly? Is it clear how the factor was identified? Every checklist coded as N.A, YES, or NO.

E. DATA EXTRACTION STRATEGY

The following sections are considered in the data extraction process [29], [30]:

DATA EXTRACTION PROCESS

Data are extracted using data extraction items shown in Table 2.

F. DATA STORAGE

Data summary are stored in SPSS.

G. DATA SYNTHESIS

For the RQ1, the data are synthesized using tables such that any background information is placed in one table, whereas the other table will include the data classifying CSFs having the columns (S.No, Motivators, Frequency, and Percentages).

The first and the last author work is primary reviewers while the second work is secondary reviewers.

IV. RESULTS

In this phase, the critical success factors were extracted from 58 research papers and have been categorized into 21 different groups with a specific name, their frequency, and percentage. The percentage will help in decision making regarding the criticality of a success factor.

In order to answer RQ1, Table 2 shows a list of SFs (Success Factors) identified through the SLR that can lead Project Managers towards adopting agile at large-scale development team.

A factor with high frequency/percentage means that these factors are generally applicable or recognized factors in the literature. Leadership strong commitment and team autonomy (45%) is the most commonly reported SFs in our study. Similarly Cooperative organizational culture (44%) is the 2nd most cited SF in our findings. In our study, 40% of authors have cited team competency in agile development expertise and training and learning and briefing of top management on agile as a generally recognized SF.

A. FACTORS IDENTIFIED THROUGH SLR

37 % of authors have cited Customer satisfaction and Customer satisfaction as SF. 33% of authors have mentioned sustainable planning as the SF. 32% of authors said Requirements management using agile-oriented requirement management process as the SF. 26% of authors mentioned Use of automated software tools and Scheduled trainings for team members as SF. 24% authors said strong collaborations and communications as SF. 23% authors said face to face meetings as SF. 21% authors said risk management and strong executive support as SF. 14% authors said mechanism for change management as SF. 13% authors said knowledge sharing management and quality production uses pair programming as SF. 11% authors said dedicated management as SF. 9% authors said pilot project in case of no experience as SF. 6% authors said agile development environment and team encouragement as success factor SF.

B. ANALYSIS ON DIFFERENT VARIABLES

In the results section the findings related to research questions are discussed. For the analysis purpose, we have found significant difference in success factors using different variables. For significant difference chi-square (linear by linear association) test is used. For analysis of the significant difference amongst nominal and ordinal variables, the linear by linear chi-square test is considered more powerful as compared to Pearson chi-square test [32].

TABLE 3. Success factors identified through SLR.

S.No.	Success Factors	Frequency 58	Percentage
1	Strong executive support	12	21%
2	Cooperative organizational culture	25	44%
3	Face to face meetings	13	23%
4	Dedicated management	6	11%
5	Team competency agile development expertise	23	40%
6	Agile development environment	03	06%
7	Team encouragement	03	06%
8	Customer satisfaction	21	37%
9	Strong collaboration with customer	21	37%
10	Sustainable planning	19	33%
11	Use of automated software tools	15	26%
12	Scheduled trainings for team members	15	26%
13	Strong collaborations and communications	14	25%
14	Risk management	12	21%
15	Knowledge sharing management	07	13%
16	Quality production using pair programming	07	13%
17	Mechanism for change management	08	14%
18	Leadership strong commitment and team autonomy	26	45%
19	Pilot project in case of no experience	05	9%
20	Training and learning and briefing of top management on agile	23	40%
21	Requirements management using agile-oriented requirement management process	18	32%

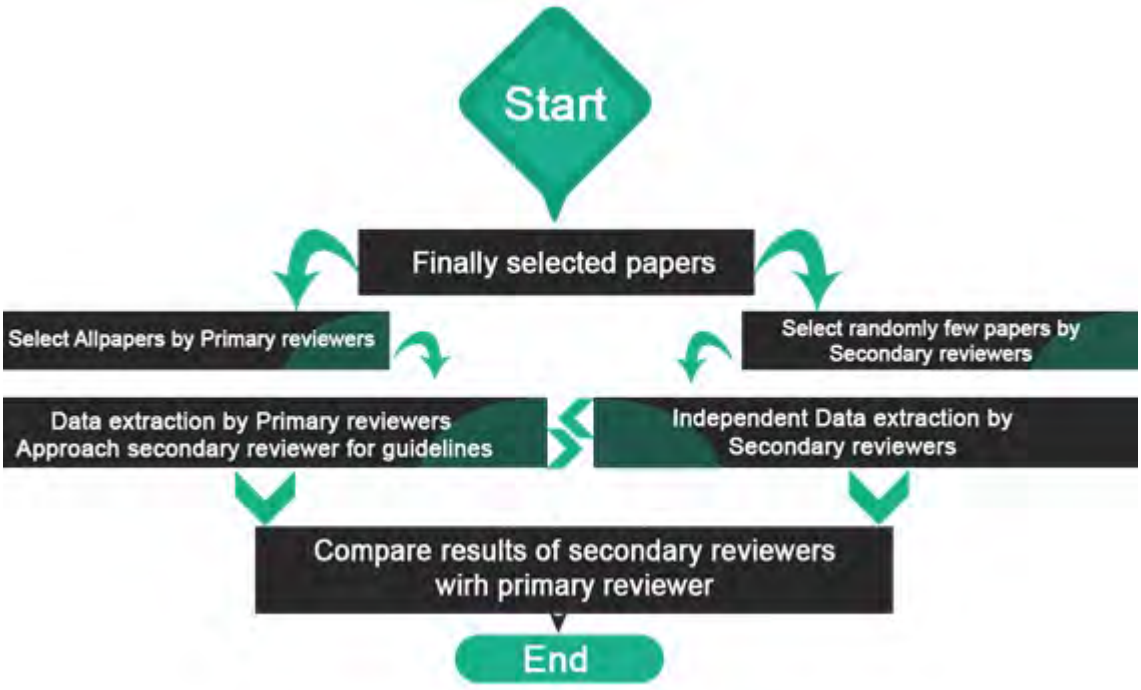

FIGURE 3. Shows data extraction process.

1) COMPARISON OF THE FACTORS ACROSS VARIOUS CONTINENTS

The data comparisons between different continents, i.e., Asia, Europe, and North America are shown in Table 3 and Fig. 3. The data from other continents have been ignored because of low sample size. The objective of this analysis is to find out any differences in these continents with respect to the identified SFs. We have used the linear-by-linear association chi-square test to find any significant difference between barriers throughout the continents.

Success factors found in various continents are listed in Table 4. The final samples of the papers are grouped into different contents based on the study location. The number of papers identified for some of the continents was very small in numbers that's why we have only compared the SFs identified in three continents, i.e. Asia, America, Europe and mixed (having combination of two or more continents), because. The aim of this analysis is to find whether these SFs differ from continent to continent. Cooperative organizational culture is critical in Asia, Europe, America and Mixed type.

TABLE 4. Summary of the identified motivators across four continents.

Factors	Occurrence in SLR (n=58)										Chi-square Test (Linear-by-Linear Association) α = .05		
Contents	Asia (N=8)		Europe(N=19)		America(N=11)		Mixed (N=19)		Africa (N=1)		X2	Df	p
Frequency/Percentage	%	F	%	f	%	F	%	f	%	f			
Strong executive support	13	1	21	4	18	2	26	5	0	0	.305	1	**.581**
Cooperative organizational culture	63	5	37	7	36	4	47	9	0	0	.219	1	**.640**
Face to face meetings	25	2	21	4	18	2	26	5	0	0	.002	1	**.969**
Dedicated management	13	1	5	1	18	2	11	2	0	0	.030		**.862**
Team competency in agile development expertise	50	4	26	5	64	7	37	7	0	0	.012	1	**.914**
Agile development environment	0	0	11	2	1	1	0	0	0	0	.462	1	**.497**
Team encouragement	13	1	5	1	0	0	5	1	0	0	.462	1	**.497**
Customer satisfaction	63	5	21	4	27	3	47	9	0	0	.000	1	**.986**
Strong collaboration with customer	63	5	21	4	27	3	47	9	0	0	.000	1	**.986**
Sustainable planning	50	4	11	2	36	4	47	9	0	0	.813	1	**.367**
Use of automated software tools	63	5	11	2	27	3	26	5	0	0	.829	1	**.363**
Scheduled trainings for team members	63	5	11	2	27	3	26	5	0	0	.829	1	**.363**
Strong collaborations and communications	38	3	21	4	27	3	21	4	0	0	.522	1	**.470**
Risk management	13	1	5	1	36	4	32	6	0	0	2.949	1	**.086**
Knowledge sharing management	13	1	11	2	1	1	16	3	0	0	.062	1	**.803**
Quality production using pair programming	25	4	11	2	0	0	16	3	0	0	.225	1	**.635**
Mechanism for change management	13	1	5	1	27	3	16	3	0	0	.436	1	**.509**
Leadership strong commitment and team autonomy	25	4	42	8	55	6	47	9	100	1	1.566	1	**.211**
Pilot project in case of no experience	25	4	5	1	1	1	5	1	0	0	1.378	1	**.240**
Training and learning and briefing of top management on agile	75	6	26	5	36	4	37	7	100	1	.349	1	**.555**
Requirements management using agile-oriented requirement management process	50	4	21	4	36	4	26	5	100	1	.028	1	**.867**

TABLE 5. Distribution of SFS across four continents.

SNO	NO. OF CSFS (CITED IN >=30% OF THE ARTICLES)	CONTINENTS
1	Cooperative Organizational Culture	Asia,Europe,America,Mixed
2	Team Competency Agile development expertise	Asia,America,Mixed
3	Customer satisfaction	Asia, Mixed
4	Strong collaboration with customer	Asia, Mixed
5	Sustainable planning	Asia,America,Mixed
6	Use of automated software tools	Asia
7	Scheduled trainings for team members	Asia
8	Training and Learning and Briefing of Top Management On Agile	Asia,America,Mixed, Africa
9	Requirements management using agile-oriented requirement management process	Asia,America,Africa
10	Strong collaborations and communications	Asia, Mixed
11	Leadership Strong Commitment and Team autonomy	Europe,America,Mixed,Africa
12	Risk management	America, Mixed
13	Requirements management using agile-oriented requirement management process	America, Africa

Team competency and agile development expertise is also critical in Asia, America and Mixed type. Customer satisfaction and Strong collaboration with customer are critical in Asia and Mixed Sustainable planning is critical in Asia, Mixed and America Scheduled trainings for team members, Use of automated software tools and Strong collaboration and communication are critical in Asia only. Risk Management is critical in America and Mixed type. Training and learning, and briefing of top management on agile is critical in Asia, Africa, and America and Mixed type. Leadership strong commitment and team autonomy is critical in America, Africa, Mixed and Europe Requirements management using agile-oriented requirement management processes is critical in Asia, America and Africa.

a: COMPARISON OF SFS BASED ON STUDY STRATEGY USED

Table 5 and Fig. 4, show our SLR results for RQ1 grounded on the study method used. We have grouped our final sample of articles, identified through the SLR, based on the study method used i.e. interviews(I), case studies(CS), literature reviews (LR), surveys(S), systematic literature reviews (SLR), experience report (ER), thesis (T), experimental study (ES) and other (other than listed). These eight study

TABLE 6. Summary of SFS based on study strategies.

Factors	Occurrence in SLR (n=58)														Chi-Square Test a = .05	
	CS (N=17)		I (n=6)		S (n=10)		SLR (n=2)		LR (n=5)		ER (n=13)		Other (n=5)			
	f	%	f	%	f	%	f	%	f	%	f	%	f	%	X2	p
Strong executive support	4	24	2	33	2	20	1	50	1	20	2	15	0	0	1.479	**.224**
Cooperative organizational culture	6	35	1	17	7	70	1	50	4	80	4	31	2	40	.060	**.807**
Face To Face meetings	3	18	1	17	4	40	0	0	3	60	2	15	0	0	.273	**.602**
Dedicated management	1	6	0	0	3	30	1	50	0	0	1	8	0	0	.146	**.702**
Team Competency in Agile development expertise	6	35	2	33	8	80	0	0	2	40	5	38	0	0	1.430	**.232**
Agile development environment	0	0	1	17	2	20	0	0	0	0	0	0	0	0	.536	**.464**
Team encouragement	1	6	0	0	1	10	0	0	0	0	1	8	0	0	.069	**.793**
Customer satisfaction	7	41	3	50	7	70	1	50	2	40	1	8	2	40	.719	**.396**
Strong collaboration with customer	8	47	3	50	7	70	1	50	2	40	1	8	2	40	.719	**.396**
Sustainable planning	4	24	2	33	5	50	1	50	3	60	4	31	0	0	.241	**.624**
Use of automated software tools	2	12	1	17	5	50	1	50	1	20	4	31	1	20	.410	**.522**
Scheduled trainings for team members	2	12	1	17	5	50	1	50	1	20	4	31	1	20	.410	**.522**
Strong collaborations and communications	2	12	2	33	4	40	0	0	2	40	3	23	1	20	.142	**.706**
Risk management	2	12	2	33	2	20	1	50	1	20	3	23	1	20	.204	**.652**
Knowledge sharing management	3	18	0	0	1	10	0	0	2	40	1	8	0	0	.397	**.529**
Quality Production Using pair programming	2	12	0	0	1	10	1	50	1	20	2	15	0	0	.000	**.993**
Mechanism for Change Management	1	6	2	33	3	30	1	50	0	0	1	8	0	0	.726	**.394**
Leadership Strong Commitment and Team autonomy:	7	41	2	33	5	50	1	50	4	80	5	38	2	40	.029	**.866**
Pilot Project in case of no experience:	2	12	0	0	1	10	0	0	0	0	2	15	0	0	.081	**.776**
Training and Learning and Briefing of Top Management On Agile	4	29	2	33	7	70	1	50	1	20	6	46	2	40	.018	**.894**

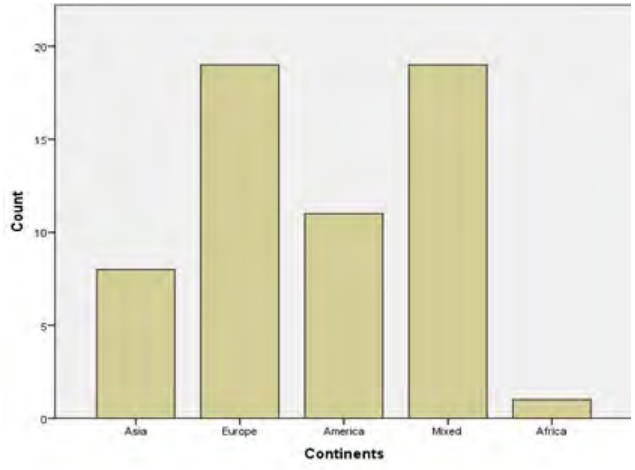

FIGURE 4. Continents wise distribution of research papers.

strategies were identified the by primary reviewer (author) and validated by the secondary reviewer (co-authors) using the inter-ratter reliability test. We have identified various distinct SFs; across these eight study strategies.

b: DISTRIBUTION OF SFS BASED ON STUDY STRATEGY USED

Different SFS were reported with different weights across eight study method as shown in Table 6, for example. Strong Executive support is critical in Interview and SLR Cooperative organizational culture is critical in the case study, SLR, experience report, literature review, and survey Face to face meeting is critical in the literature review and survey Dedicated management is critical in survey and SLR. Team competency in agile expertise is critical in the case study, survey, interview, literature review, and experience report. Customer satisfaction is critical in the case study, survey, interview, literature review, SLR and other. Strong collaboration with customer is critical in the case study, interview, survey, SLR, literature review and other. Sustainable planning is critical in the interview, SLR, experience report, survey and literature review. Use of automated software tool is critical in the survey, SLR and experience report. Strong collaborations and communications are critical in interview, survey, and literature review. Risk management is critical in SLR and interview. Knowledge sharing management is critical in literature review Quality Production Using Pair Programming management is critical in SLR. Mechanism for Change Management is critical in Interview, survey, and SLR. Leadership Strong Commitment and Team autonomy is critical in case study, Interview, Survey, SLR, experience report, other and literature review Requirements management using agile-oriented requirement management processes is critical in case study, survey, SLR, and experience report. The remaining is critical in none of the study strategy as shown in Table 6. Table 6 divulges that case study and experience report are the utmost used study strategies in our study. These findings can be used in order to identify the position of the various research methodologies i.e., which study method is more influential for producing information. These findings may also assist researcher working in the field of empirical software engineering in the production of their research designs.

c: COMPARISON OF SFS BASED ON COMPANY SIZE

Table 7 and Fig. 5 show our SLR results grounded on the company size used.

We have grouped organization into small, large, medium, mixed and unknown type. The chi-square test illustrates a significant difference for face to face meetings and requirements management using agile-oriented requirement management processes.

TABLE 7. Distribution of SFS across various study strategies.

SNO	NO. OF CSFS (CITED IN >=30% OF THE ARTICLES)	STUDY STRATEGIES
1	Cooperative Organizational Culture	Case Study, Survey. Literature Review, Experience Report, Other
2	Team Competency Agile development expertise	Case Study, Interview, Survey, Literature Review, Experience Report
3	Customer satisfaction	Case Study, Interview, Survey, SLR, Literature Review, Other
4	Strong collaboration with customer	Case Study, Interview, Survey, SLR, Literature Review, Other
5	Sustainable planning	Interview, Survey, SLR, Literature Review, Experience Report,
6	Use of automated software tools	Survey, SLR, Experience Report
7	Scheduled trainings for team members	Survey, SLR, Experience Report
8	Training and Learning and Briefing of Top Management On Agile	Interview, Survey, SLR, Experience Report, Other
9	Requirements management using agile-oriented requirement management process	Case Study, Survey, SLR, Experience Report
10	Strong collaborations and communications	Interview , Survey, Literature Review
11	Leadership Strong Commitment and Team autonomy	Case Study, Interview, Survey, SLR, Literature Review, Experience Report, Other
12	Risk management	Interview, SLR,
13	Requirements management using agile-oriented requirement management process	
14	Strong Executive Support	Interview, SLR,
15	Strong collaborations and communications	Interview, Survey, Literature Review
16	Mechanism for change management	Interview, Survey, SLR
17	Face To Face Meetings	Survey, Literature Review,
18	Dedicated Management	Survey, SLR
19	Quality production using pair programming	SLR
20	Knowledge sharing management	Literature Review

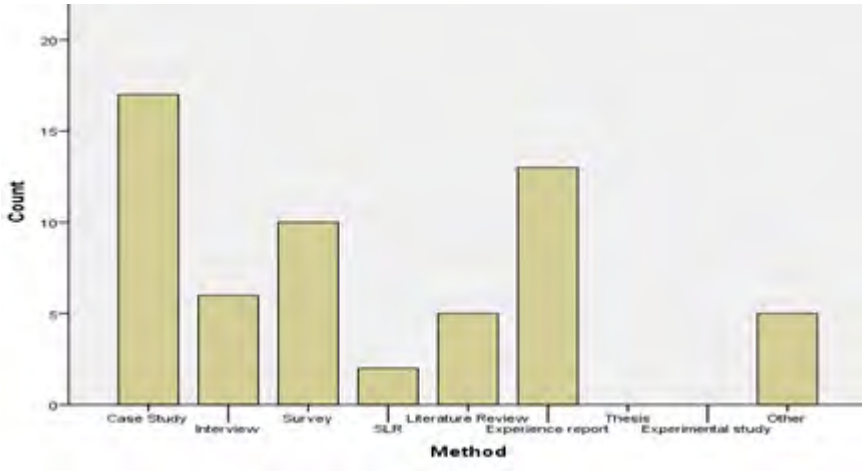

FIGURE 5. Study strategies-wise distribution of research papers.

d: DISTRIBUTION OF SFS BASED ON COMPANY SIZE

The results of our SLR study signpost that 21 out of 21 SFs have been described in the related literature of organization size small, medium, large, and mixed as shown in Table 8. However, different SFs were reported with different weights across eight study method, for example. Cooperative organizational culture, use of automated software tools, scheduled trainings for team members, training and learning and briefing of top management on agile and requirements management using agile-oriented requirement management process is critical in small and medium. Team competency in agile development expertise, customer satisfaction and strong collaboration with customer, strong collaborations and communications is critical in medium. Strong executive support, face to face meetings, cooperative organizational culture, team competency in agile development expertise, customer satisfaction, strong collaboration with customer, strong collaboration with customer, risk management, leadership strong commitment and team autonomy, training and learning and briefing of top management on agile and knowledge sharing management is critical in unknown Cooperative organizational culture, sustainable planning, leadership strong commitment and team autonomy, training and learning and briefing of top management on agile and team competency in agile development expertise is critical in large. Quality production using pair programming and pilot project in case of no experience is critical in small Leadership strong commitment and team autonomy is critical in small medium Strong executive support, cooperative organizational culture, face to face meetings, team competency in agile development

TABLE 8. Summary of SFS based on company size.

Factors	Occurrence in SLR (n=58)										Chi-square Test a = .05	
	Small N=2		Medium n=2		Large n=32		Mixed n=19		Unknown n=3			
	f	%	F	%	f	%	f	%	f	%	X2	p
Strong executive support	0	0	0	0	5	16	6	32	1	33	2.851	**.091**
Cooperative organizational culture	1	50	1	50	13	41	8	47	1	33	.004	**.949**
Face to face meetings	0	0	0	0	5	16	7	37	1	33	3.653	**.056**
Dedicated management	0	0	0	0	2	9	3	16	0	0	.326	**.568**
Team competency in agile development expertise	0	0	1	50	13	41	7	42	1	33	.254	**.615**
Agile development environment	0	0	0	0	1	3	2	11	0	0	.596	**.440**
Team encouragement	0	0	0	0	1	3	2	11	0	0	.596	**.440**
Customer satisfaction	0	0	2	100	9	28	8	47	1	33	.550	**.458**
Strong collaboration with customer	0	0	2	100	9	28	8	47	1	33	.550	**.458**
Sustainable planning	0	0	0	0	10	31	7	37	2	66	2.926	**.087**
Use of automated software tools	1	50	1	50	8	25	4	26	0	0	1.251	**.263**
Scheduled trainings for team members	1	50	1	50	8	25	4	26	0	0	1.251	**.263**
Strong collaborations and communications	0	0	1	50	8	25	4	26	0	0	.053	**.818**
Risk management	0	0	0	0	5	16	6	32	1	33	2.851	**.091**
Knowledge sharing management	0	0	0	0	4	13	2	11	1	33	.776	**.378**
Quality production using pair programming	1	50	0	0	1	6	3	21	0	0	.023	**.880**
Mechanism for change management	0	0	0	0	4	13	3	21	0	0	.452	**.501**
Leadership strong commitment and team autonomy	1	50	2	100	10	34	8	47	3	100	.704	**.401**
Pilot project in case of no experience	1	50	0	0	2	9	1	5	0	0	2.496	**.114**
Training and learning and briefing of top management on agile	2	100	1	50	10	34	7	42	1	33	.759	**.384**
Requirements management using agile-oriented requirement management process	2	100	2	100	8	25	6	32	0	0	4.591	**.032**

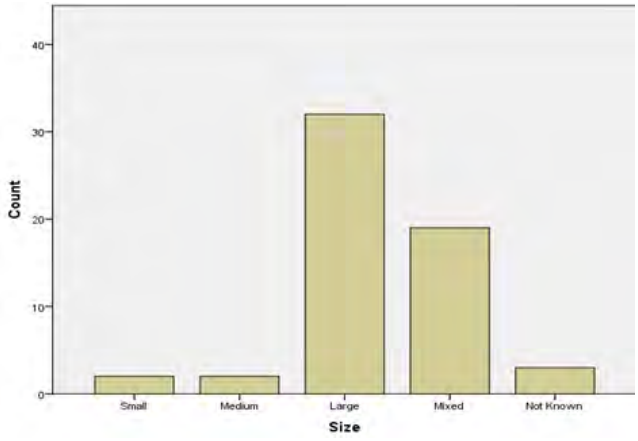

FIGURE 6. Various company size wise distributions of research papers.

expertise, customer satisfaction, strong collaboration with customer, sustainable planning, risk management, leadership strong commitment and team autonomy, training and learning and briefing of top management on agile and requirements management using agile-oriented requirement management process is critical in mixed.

e: COMPARISON OF SFS BASED ON STUDY SEARCH VENUES

Table 9 and Fig. 6, show our SLR results for RQ1 grounded on the organization size used.

We have search IEEEXplore, Science Direct, ACM, Springer Link, and Google Scholar as search venues.

The chi-square test illustrates a significant difference for cooperative organizational culture, customer satisfaction, strong collaboration with customer, strong collaborations and communications and mechanism for change management.

f: DISTRIBUTION OF SFS BASED ON STUDY SEARCH VENUES

The results of our SLR study signpost that 21 out of 21 SFs have been described in the related literature in libraries IEEEXplore, Science Direct, ACM, Springer Link and Google Scholar, as shown in Table 10. For example; Sustainable planning, leadership strong commitment and team autonomy, training and learning and briefing of top management on agile and requirements management using agile-oriented requirement management processes are critical in IEEEXplore. Cooperative organizational culture, Sustainable planning and Leadership Strong Commitment and Team autonomy are critical in ACM. Cooperative organizational culture, face to face meetings, team competency agile development expertise, customer satisfaction, strong collaboration with customer, strong collaborations and communications, training and learning and briefing of top management on agile and leadership strong commitment and team autonomy are critical in ScienceDirect.

Leadership strong commitment and team autonomy is critical in SpringerLink. Cooperative organizational culture, face to face meetings, team competency in agile development expertise, customer satisfaction, strong collaboration with customer, strong collaborations and communications, sustainable planning, use of automated software tools, scheduled trainings for team members, risk management, requirements management using agile-oriented requirement management process, training and learning and briefing of top management on agile and leadership strong commitment and team autonomy are critical in Google Scholar.

TABLE 9. Distribution of SFS across various company sizes.

Size	No. of Factors	No. of CSFs (cited in >=30% of the articles)
Small (N = 2)	8	1. Cooperative organizational culture 2. Use of automated software tools 3. Scheduled trainings for team members 4. Quality production using pair programming 5. Leadership strong commitment and team autonomy 6. Pilot project in case of no experience 7. Training and learning and briefing of top management on agile 8. Requirements management using agile-oriented requirement management process
Medium (N=2)	8	1. Cooperative organizational culture 2. Use of automated software tools 3. Scheduled trainings for team members 4. Training and Learning and Briefing of Top Management On Agile 5. Requirements management using agile-oriented requirement management 6. Team Competency Agile development expertise 7. Customer satisfaction 8. Strong collaboration with customer 9. Strong collaborations and communications 10. Leadership Strong Commitment and Team autonomy
Large (N=32)	21	1. Cooperative organizational culture 2. Sustainable planning 3. Leadership strong commitment and team autonomy 4. Training and learning and briefing of top management on agile 5. Team competency in agile development expertise
Mixed (N=19)	21	1. Strong executive support 2. Cooperative organizational culture 3. Face to face meetings 4. Customer satisfaction 5. Strong collaboration with customer 6. Sustainable planning 7. Risk management 8. Leadership strong commitment and team autonomy 9. Training and learning and briefing of top management on agile 10. Requirements management using agile-oriented requirement management process 11. Team competency in agile development expertise.

TABLE 10. Summary of SFS based on various search venues.

Factors	Occurrence in SLR (n=58)										Chi-square Test a = .05	
	Search libraries											
	IEEE Xplore (n=18)		ACM (n=6)		Science Direct (n=8)		Springer Link (n=6)		Google Scholar (n=20)			
	F	%	f	%	F	%	f	%	f	%	X2	p
Strong executive support	5	28	0	0	2	25	0	0	4	25	.033	**.856**
Cooperative organizational culture	4	22	2	33	5	63	1	17	13	65	4.910	**.027**
Face to face meetings	1	6	0	0	3	38	1	17	8	40	6.329	**.012**
Dedicated management	1	6	1	17	1	13	0	0	3	15	.334	**.564**
Team competency in agile development expertise	5	28	1	17	5	63	1	17	11	55	2.258	**.133**
Agile development environment	0	0	0	0	2	25	0	0	1	5	.158	**.691**
Team encouragement	0	0	0	0	1	13	0	0	2	10	1.488	**.223**
Customer satisfaction	3	17	1	17	4	50	0	0	13	65	7.134	**.008**
Strong collaboration with customer	3	17	1	17	4	50	0	0	13	65	7.134	**.008**
Sustainable planning	7	39	2	33	1	13	0	0	9	45	.023	**.879**
Use of automated software tools	4	22	0	0	2	25	0	0	9	45	2.431	**.119**
Scheduled trainings for team members	4	22	0	0	2	25	0	0	9	45	2.431	**.119**
Strong collaborations and communications	2	11	0	0	3	38	0	0	9	45	5.001	**.025**
Risk management	4	22	0	0	1	13	0	0	7	35	1.037	**.308**
Knowledge sharing management	1	6	0	0	2	25	0	0	4	20	1.414	**.234**
Quality production using pair programming:	1	6	1	17	1	13	0	0	4	20	1.006	**.316**
Mechanism for change management	1	6	0	0	1	13	1	17	5	25	3.659	**.056**
Leadership strong commitment and team autonomy	7	39	2	33	3	38	2	33	12	60	1.660	**.198**
Pilot project in case of no experience	3	17	0	0	1	13	0	0	1	5	1.461	**.227**
Training and learning and briefing of top management on agile	7	39	0	0	5	63	0	0	11	55	.778	**.378**
Requirements management using agile-oriented requirement management process	6	33	1	17	2	25	0	0	9	45	.379	**.538**

g: COMPARISON OF SUCCESSES FACTORS BASED ON DECADES

We have divided search periods into three decades, the first decade is from 1992 to 2002, the second decade is from 2003-2013 and third decade is from 2014 to 2016 as presented in Table 11 and pastoralized in Fig. 7. In our trail search, we have found that no research paper has been found before 2003 which discussed the adoption of ASDM. Our

TABLE 11. Distribution of SFS across different libraries.

Library Name	No. of Factors	No. of CSFs (cited in ¿=30% of the articles)
IEEEXplore (N=18)	19	1. Sustainable planning 2. Leadership strong commitment and team autonomy 3. Training and learning and briefing of top management on agile 4. Requirements management using agile-oriented requirement management process
ACM (N=9)	9	1. Cooperative organizational culture 2. Sustainable planning 3. Leadership strong commitment and team autonomy
ScienceDirect (N=8)	21	1. Cooperative organizational culture 2. Face to face meetings 3. Team competency agile development expertise 4. Customer satisfaction 5. Strong collaboration with customer 6. Strong collaborations and communications 7. Training and learning and briefing of top management on agile 8. Leadership strong commitment and team autonomy
Springer Link (N=6)	5	1. Leadership Strong Commitment and Team autonomy
GoogleScholar (N=20)	21	1. Cooperative organizational culture 2. Face to face meetings 3. Team competency in agile development expertise 4. Customer satisfaction 5. Strong collaboration with customer 6. Strong collaborations and communications 7. Sustainable planning 8. Use of automated software tools 9. Scheduled trainings for team members 10. Risk Management 11. Requirements management using agile-oriented requirement management process 12. Training and learning and briefing of top management on agile 13. Leadership strong commitment and team autonomy

TABLE 12. Summary of SFS based on decades.

Factors	Occurrence in SLR (n=58)					
	2003-2013 (n=36)		2014-2016 (n=22)		Chi-square Test a = .05	
	F	%	f	%	X2	p
Strong executive support	6	17	6	27		
Cooperative organizational culture	16	44	9	41	.068	**.794**
Face To Face meetings	8	22	5	23	.002	**.965**
Dedicated Management	4	11	2	9	.059	**.808**
Team Competency in Agile development expertise	15	42	8	36	.158	**.691**
Agile development environment	2	6	1	5	.028	**.867**
Team encouragement	3	8	0	0	1.900	**.168**
Customer satisfaction	11	31	10	45	1.290	**.256**
Strong collaboration with customer	11	31	10	45	1.290	**.256**
Sustainable planning	11	31	8	36	.206	**.650**
Use of automated software tools	11	31	4	18	1.072	**.301**
Scheduled trainings for team members	11	31	4	18	1.072	**.301**
Strong collaborations and communications	9	25	5	23	.038	**.846**
Risk Management	6	17	6	27	.920	**.337**
Knowledge sharing management	5	14	2	9	.291	**.590**
Quality Production Using pair programming	4	11	3	14	.081	**.776**
Mechanism for Change Management	1	3	7	32	9.518	**.002**
Leadership Strong Commitment and Team autonomy	14	39	12	55	1.330	**.249**
Pilot Project in case of no experience	3	8	2	9	.010	**.921**
Training and Learning and Briefing of Top Management On Agile	16	44	7	32	.894	**.344**
Requirements management using agile-oriented requirement management process	10	28	8	36	.462	**.497**

search and results also show that this is new area of ASD maturing since 2003 and limited numbers of researchers has contributed to this.

The chi-square test illustrates a significant difference for Mechanism for Change Management.

h: DISTRIBUTION OF SUCCESSES FACTORS BASED ON DECADES

We found critical motivators in different decades as shown in Table 12, and summarized as follow. Cooperative organizational culture, team competency in agile development

TABLE 13. Distribution of SFS across decades.

Decades	No. of Factors	No. of CSFs (cited in >= 30% of the articles)
Decade 1 2003-2013 (N=36)	21	1. Cooperative organizational culture 2. Team competency in agile development expertise 3. Customer satisfaction 4. Strong collaboration with customer 5. Sustainable planning 6. Use of automated software tools 7. Scheduled trainings for team members 8. Leadership strong commitment and team autonomy 9. Training and learning and briefing of top management on agile
Decade 2 2014-2016 (N=22)	20	1. Cooperative organizational culture 2. Team competency in agile development expertise 3. Customer satisfaction 4. Strong collaboration with customer 5. Sustainable planning 6. Mechanism for change management 7. Leadership strong commitment and team autonomy 8. Training and learning and briefing of top management on agile 9. Requirements management using agile-oriented requirement management process

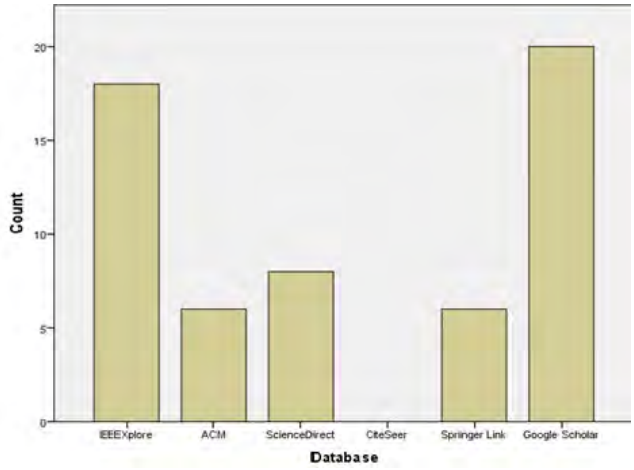

FIGURE 7. Various search venue wise distributions of research papers.

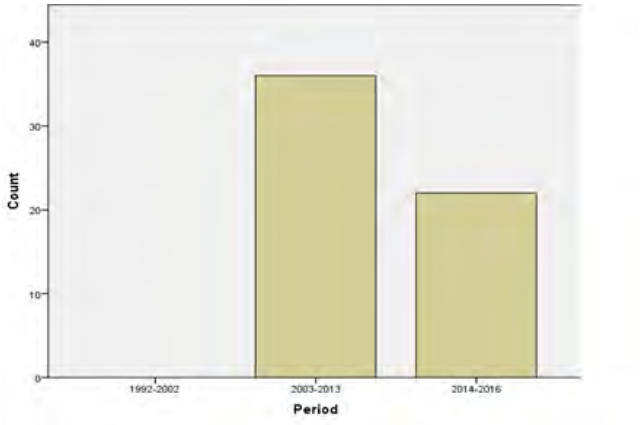

FIGURE 8. Various time wise distributions of research papers.

expertise, customer satisfaction, strong collaboration with customer, sustainable planning, use of automated software tools, scheduled trainings for team members, leadership strong commitment and team autonomy and training and learning and briefing of top management on agile are critical in decade1.

Cooperative organizational culture, Team Competency in Agile development expertise, Customer satisfaction, Strong collaboration with customer, Sustainable planning, Mechanism for Change Management, Leadership Strong Commitment and Team autonomy, Training and Learning and Briefing of Top Management On Agile and Requirements management using agile-oriented requirement management process are critical in Decade2.

V. CONCLUSION AND FUTURE WORK

Through SLR, we have identified different Motivators that should be addressed and keep in view by project manager when adopting software development for large scale development team. In our study, the defined criteria for the criticality of success are 30%, the Motivators which have percentage greater than the defined percentage; it will be considered as critical. Our research reveals some of the Motivators need special attention because their occurrence creates more motivation by adopting agile at large scale. We also found that the impact of different motivators through different decades and continents for project manager guidance because some Motivators were most critical in one region while less critical in other regions. Similarly, some of the motivators were more critical in the previous decade but less critical presently because of different improvements in software processes and technologies.

There are 58 research papers selected through SLR for conducting this research. In these research papers, maximum have been written and published by scholars, academics and faculty members of the universities. Most of these researchers may not have the practical experience of managing the agile software development at a large scale. Theoretical work has been done by most of the researchers. We have used these research papers for finding the Motivators in adopting agile at large scale from management perspective. Now problem is that up to what extent our research findings are valid? To prove these findings correct and to the point, we plan to conduct questionnaire survey and empirical study in the software industry and take feedback of practitioners who practically working in the agile software development environment and to find other motivators apart from identified

one which has been skipped in this study. Through SLR, we have identified 21 different motivators for adopting agile at large scale as shown in Table 2. These identified motivators may help the project manager when adopting agile at large-scale development team. These motivators are also analyzed from different angles like decade wise and continent wise for project managers guidance. In our study we have identified following future goals that we will follow in future: The validation of identified motivators by using the technique of questionnaire survey and empirical study with the help of experts and practitioners working in Agile Software Development environment. In future, we want to rank the factors using the fuzzy multi criteria decision making process. Additional motivators will also be identified from experts and practitioners through empirical study if any.

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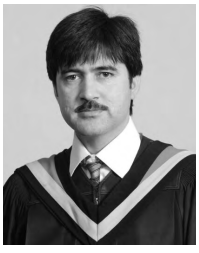

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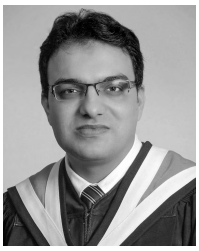

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