Comparative analysis of scrum and XP in Pakistani software industry

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ABSTRACT

Agile methodologies promise to improve the productivity of software projects. Scrum and Extreme Programming (XP) are the most important agile methodologies. Both of the methodologies have a different framework and different style of implementations. These methodologies inherit the principles of agility. In order to implement these methodologies, the focus is on the agile manifesto. This research work presents exclusive evidence from Pakistani Software Industry for the comparison between Scrum and XP. The main focus of the research is to examine the similarities and differences by using a comparison between Scrum and XP in Pakistani Software Industrial context. The study is aimed to improve the quality of products and services, efficiency, and effectiveness of the developmental process and bring agility to the software development organization. The research is also focused to evaluate the challenges faced by software houses in the implementation of Scrum and XP. This study provides a solution to those challenges. A set of guidelines is presented to ensure the possibility of using both of them in one project.

Keywords: agile software development; traditional software development; XP; scrum; Pakistan; feature driven development;

1. INTRODUCTION

Traditional software development (TSD) is the old version for the software development among all the software development methodologies. Methodologies under the TSD are less flexible and the developers are unable to get the desired outcome. The life style of people is changing day by day and their plans also change thus, they demand the change in their requirements, which is not easy with TSD. In order to overcome such problems, agile software development methodologies (ASDM) were presented. Looking to the paradigm shift, agile was designed in such a way to solve the problems of TSD like time management, change management, quality assurance and customer collaboration. ASDM is a complete package of many lightweight methodologies. These include XP, Scrum, Crystal, DSDM, Lean development, FDD etc. Out of these lightweight processes, two methodologies are most popular; Scrum and XP. Although both these methods inherit the principles of agile development, both of them are two different frameworks. Scrum is highly concerned with project management techniques while XP is focused on engineering techniques. Both of them welcome to changes but have different agenda. Scrum is using short iteration to provide flexibility for changes to the projects, while XP welcomes to changes at any time. Section 3 completely discusses both of the frameworks.

In this research, Section 2 presents literature review, Section 3 presents the methodology and data collection techniques, followed by Section 4, which presents exclusive evidence about Scrum and XP from software industry, results are provided in Section 5, and finally conclusion is presented in Section 6.

2. LITERATURE REVIEW

Agile methodologies impose a disciplined process. A technique was introduced in 1975 based on iterative enhancement, which has become an agile methodology, to overcome the heavy nature of developmental processes. The name "agile" come about in 2001 [1, 2], when seventeen process methodologists held a meeting to discuss future trends in software development methodologies. In the methodologies of iterative enhancements, they found some common characteristics. Thus, they decided the name of agile, meaning it is both light and sufficient.

As a result of this meeting, Marten Flower and Jim Highsmith presented "agile alliance" and its manifesto emerged for software development [3-6]. The agile methods claim to place more emphasis on people, interaction, working software, customer collaboration, and change, rather than on process, tools, contracts, and plan. The agile

development methods include Scrum, Extreme Programming (XP), Featured Driven Development Model, Crystal Model and some other. All of these work on the framework provided by the agile manifesto [7].

The research in [8] presents the impacts of agile methodologies on software development in Pakistan. A survey was conducted to see the different features of Agile, their impact on software quality and productivity of employees and adoption of agile methodologies in Pakistani software houses with a sample size of n=17. The research in [9] shows that SCRUM defines a flexible strategy for the development of a software which unites the team members to focus on the product objectives only. The challenges faced in TSD, SCRUM tries to solve those challenges. The people who work under SCRUM framework will be self-organized and will behave like a team. The members of the team will be motivated and encouraged towards the objectives of the software project. The main focus of SCRUM is on the customers. The customers may change their mind at any stage of the development and want to add some new functionality to the software [9-12]. XP is one of the agile methodologies that got a tremendous response among all agile methodologies in the recent past due to its wide applications in the software development life cycle (SDLC). XP is designed in such a way that improves quality of the software development. XP advocates short releases in shorter time span [13, 14][13-15]. XP short releases help to improve the quality of the products with special check points. Through these check points, the XP welcomes to the changes requested by the customers. Due to its wider application in the developmental processes, XP has been identified the most general methodology among all agile methodologies [7, 15-17]. The research in [18] focuses on agile in Pakistan and has significant evidence from Pakistan, it shows that scrum model is the favorite model for the agile development in Pakistan with more than 40% usage and surprisingly the XP is least used and the usage percentage is less than 5.

3. MATERIALS AND METHOD

Data for this survey is collected, by using online emails, from different software professionals, working in different organizations of Pakistan. The questionnaire is divided into 3 indexes. Index 1 is used to get knowledge about the organization. On the base of index 1, it was decided to respond the index 2 or 3. The organizations that were using SCRUM were asked to respond index 2 while those using XP were asked to respond index 3. Index 1 has 5 questions only. Index 2 and 3 consists of 30 questions each. The questionnaire was sent to different software houses in the main cities of Pakistan like Karachi, Lahore, Islamabad, and Peshawar. The online data is analyzed by using an online tool provided by Google named as Google Forms.

4. ANALYSIS OF DATA

This paper presents the analysis of data collected for the survey and then compared with each other. The data is analyzed based on the following steps.

a) Data analysis strategy

For this survey, we received 30 responses out of 100 software professionals to the questionnaires. The respondents were from different software organizations working in different context. Most of them were from web development (95.5%), 45.5% were from database development, 54.5% were from desktop software development, 27.5% were concerned about game development, and 50% were from Android app development and other different IT services. 33.3% were using pure Agile Development Methodologies, 42.9% were using both agile and TSDM. 9.5% were not using Agile while 14.3% were using some hybrid technology. 72.7% of them were using agile at any point of the project and 22.7% were using agile from the initial stage of the project. The results of the survey conducted in [18] showed that scrum has the highest percentage of usage that is 66.7% while 23.8% of organizations were using XP. On the other hand, 9.5% were using both scrum and XP in their projects.

b) Comparison of evidence and comparison criteria

This survey is aimed to compare scrum and XP. Here we are going to address some issues by comparing both methods. Following is the comparison criteria of collected evidence about both methodologies.

Bar graphs are obtained by asking the same question from the respondents for both methods in the form of strongly agree, agree, neutral, disagree and strongly disagree. The number of respondents is different for questions asked for both scrum and XP. This difference is due to the reason that some organizations were using Scrum more than XP. If we look at the percentage of the usage of scrum in the projects, the 15% of our respondents were using scrum for more than 70% projects. In contemporary 18.8% of the respondents were using XP for more than 70% projects. Here we

need to keep in mind that the number of respondents to scrum is 20 while the number of respondents to XP is 18. Furthermore, following scrum 60% and 40% has the highest percentage (25% and 30%) than XP which is 25% and 12% in the same criteria with scrum. Equating both these equations and compare with the above results, we conclude that responses to scrum are more than to XP. In some context, the respondents respond to both the indexes of the questionnaires. Our evidence shows that they are using scrum more than XP but for small projects, they are also using XP. That's why they respond to XP and vice versa. The project size which implements these methodologies need to be considered. 18 respondents with the percentage of 77.8% were using scrum for medium size projects. 75% respondents out of 12 responses were using XP in small projects. This concludes that the percentage of implementing scrum for medium size projects is more than using XP for small projects development.

4.1 Requirements elicitation issue

Scrum requirements elicitation is different from XP requirements elicitation. Scrum puts all the requirements in the backlog in a priority in the form of user stories. The analysis for prioritization is done by the development team by doing pre-analysis/pre-planning. Scrum meetings are helpful for this analysis. In XP the user writes his stories on a 4X6 inches card. Each card has one requirement. Here the user himself is going to ask the developer to develop the user story for him. We asked the question "Does the Scrum help the stakeholders to decide core requirements for the system?" Figure 1 depicts the requirements elicitation in the case of scrum while Figure 2 shows the requirements elicitation in the case of XP.
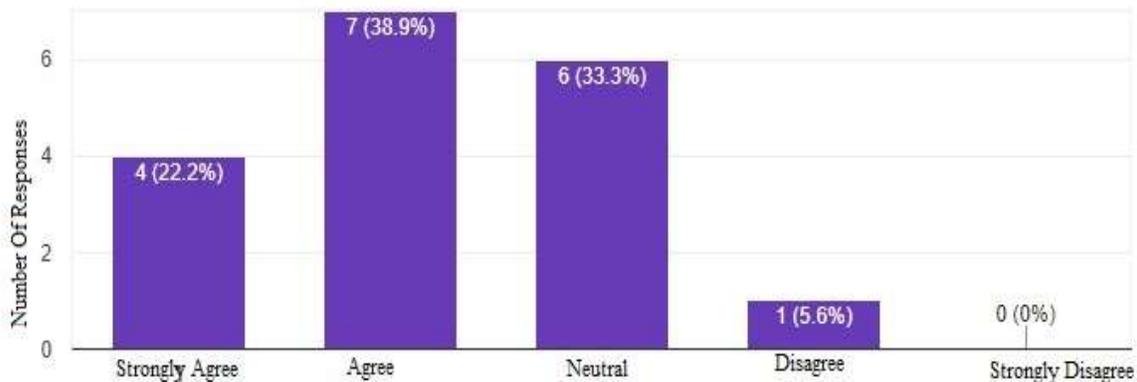

Figure. 1 Requirements elicitation in scrum
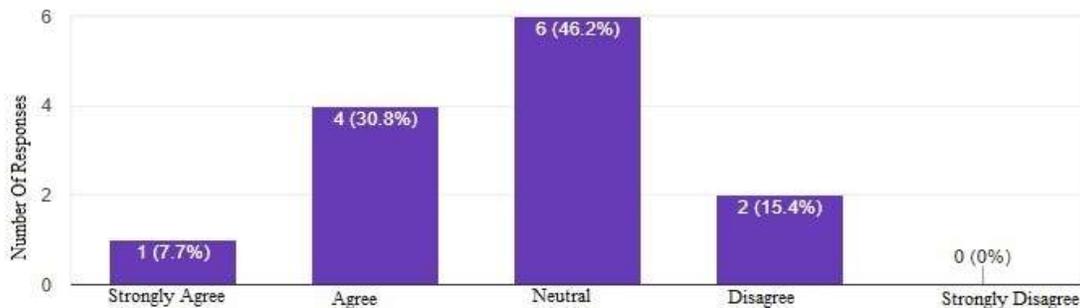
The same question is asked for XP.

Figure. 2 Requirements elicitation in XP

4.1.1 Results and recommendation

If we count the number of respondents to strongly agree and agree in scrum portion in Figure 1, it clarifies that the percentage of responding to scrum is more than the percentage of responding to XP in the same criteria in Figure 2. Thus, we concluded that scrum helps the stakeholders more than XP to decide the core requirements for the system.

4.2 Communication gap

Communication is the key to agility. Agile manifesto encourages us to communicate with stakeholders. The communication gap between the team members and other stakeholders causes problems such as misunderstanding, miscommunication etc. We ask the question, "Communication with stakeholders makes the scrum practice a difficult (crucial/critical) aspect of Agile". Figure 3 depicts the communication gap in scrum.
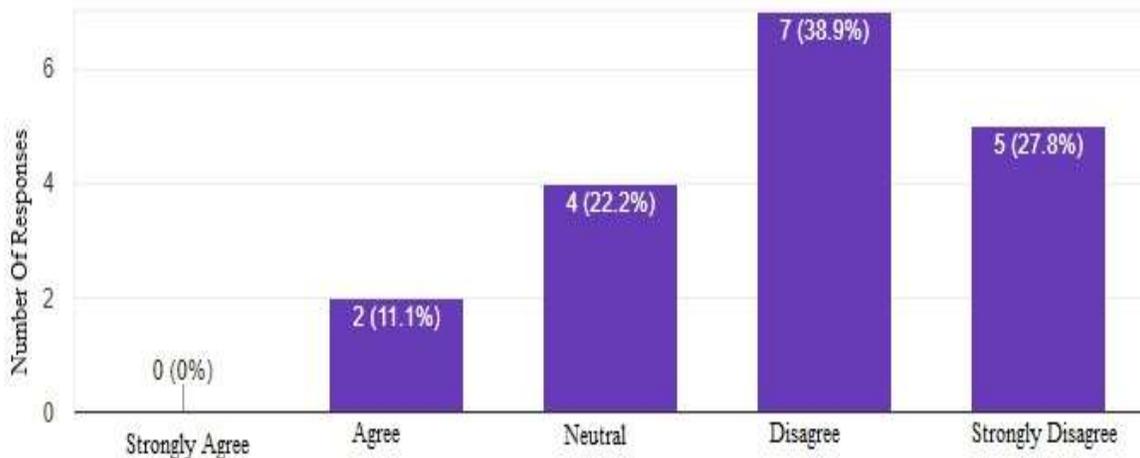
Figure. 3 Communication gap in scrum

The same question is asked from XP followers. Figure 4 depicts the communication gap in XP.
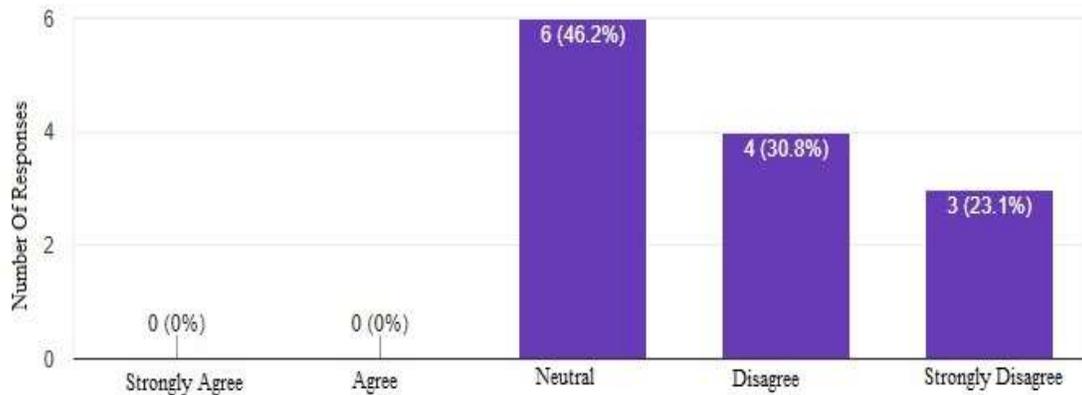

Figure. 4 Communication gap of XP

4.2.1 Results and recommendation

The percentage of respondents for both questions is different because of the number of respondents in Figure.3. On this behalf, scrum has the high percentage of disagreement with the asked question. Referring to Figure 4, we concluded that scrum is helpful to avoid communication gap more than XP. In other words, communication between the stakeholders in scrum makes the scrum more efficient than XP.

4.3 Changing requirements issues

The popularity of agile methods is due to the accommodation of changes at any stage of the development. Both scrum and XP welcome to changes with different styles. Scrum incorporates changes after the completion of a sprint. The change request is made to the scrum master after the deployment of the first deliverable. The scrum master conducts a meeting and prioritizes the change in the product backlog. XP welcomes to change through check points. If the development team is working on a feature and a change request is made, the team will stop that feature and will try to develop the change request made by the client.

We ask the question from the software professionals that, "Changing requirements make the scrum practice a difficult (crucial/critical) aspect of Agile". Figure 5 depicts the result of changing requirements in scrum.
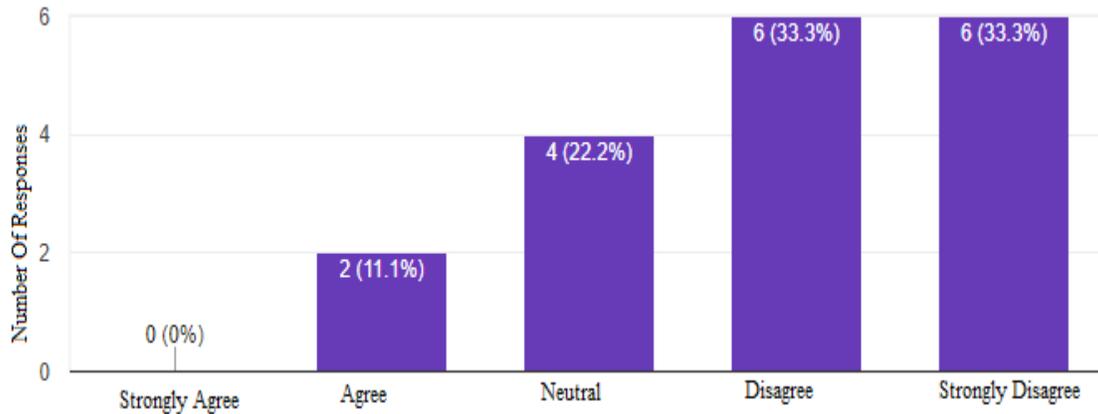

Figure. 5 Changing requirements in scrum

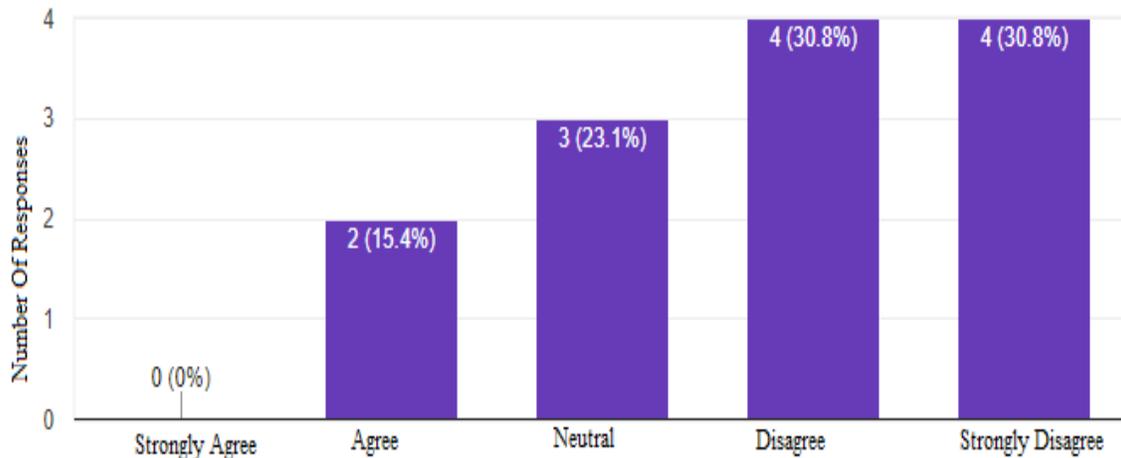The same question is asked by the software professionals. Figure 6 depicts the result of changing requirements in XP.

Figure. 6 Changing requirements in XP

4.3.1 Results and recommendation

On behalf of the number of respondents to both questions the conclusion is made that the percentage to accommodate changes in the scrum is more than XP. Although XP is in the competition to scrum, but the number of

scrum followers are more than the number of XP followers. This enables us to get a tight decision in between scrum and XP.

4.4 Time frame and cost

Time and cost of a project have a great impact on the quality of the product. Agile methods are specially developed to control both these important resources of the projects. The right product on right time with the right budget has a great mean to the market and thus an organization can survive in such situations otherwise the quality of the software products will decrease and the business values will also decrease. Here we also focused on both these.

4.4.1 Time frame

For time, we asked different questions about scrum. Like "Scrum is followed because it decreases time/duration", "If Scrum is performed properly, it results in reduced time", "If Scrum is performed properly, it results in producing right product in the right time", and "Scrum makes the development process easy with respect to time delivery". The number of responses to all four questions is same and their results are also almost the same. Figure 7 shows the obtained results.

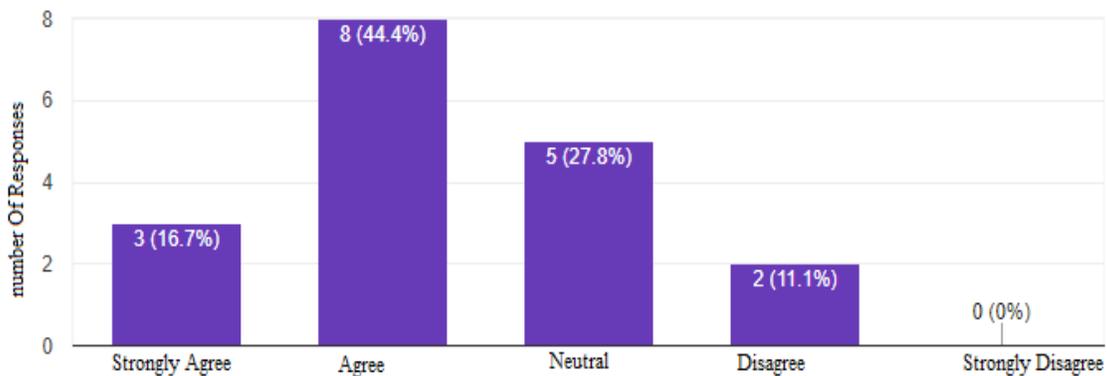**Scrum is followed because it decreasesTime/Duration**

18 responses

Figure. 7 Time management in scrum

The same questions were asked about XP. Once again, the number of responses to all these four questions is same and their results are also almost the same. Figure 8 shows the obtained results.

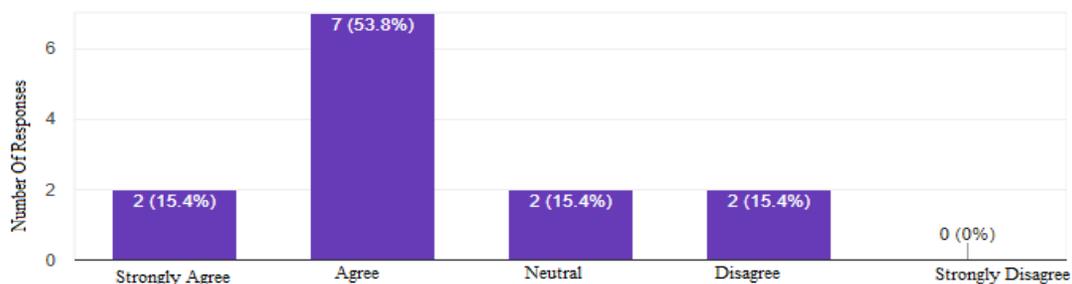**XP is followed because it decreasesTime/Duration**

13 responses

Figure. 8 Time management in XP

a) Results and recommendation

Comparing the above results, we concluded our results with some different aspects i.e. the number of disagreements. The number of respondents to the disagreements of questions about scrum has less percentage than XP as shown in Figure 7. Disagreements with XP in Figure 8 may have the possibility that the respondent who responds to the 1st question has also the possibility to respond the 2nd question in the same criteria and so on but we will ignore that. But this case is not valid for the scrum. Moreover, we need to keep in mind the size of the projects. All these evidences conclude that time management in scrum has high success rate than XP. We cannot ignore XP here. XP gives these results in small projects. Keeping the project size in mind, if we apply scrum to small projects, it will not make any sort of sense because we are wasting our time by applying scrum to small projects. Thus, XP has these applications in small projects which are efficient. We need to try in implementing the time frame of XP in scrum projects. This is one of the guidelines that we are going to present in the next sections.

4.4.2 Cost

For cost: we asked some different questions about scrum. Like "Scrum is followed because it decreases development costs", "If Scrum is performed properly, it results in increased business value", "If Scrum is performed properly, it results in reduced budget", "Small budget makes the scrum practice, a difficult (crucial/critical) aspect of Agile", "Limited project resources make the scrum practice, a difficult (crucial/critical) aspect of Agile". Figure 9 shows the obtained results.
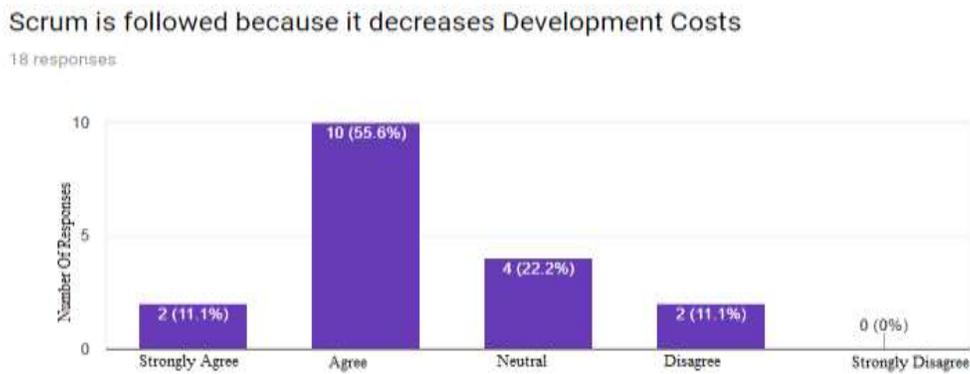

Figure. 9 Cost management in scrum

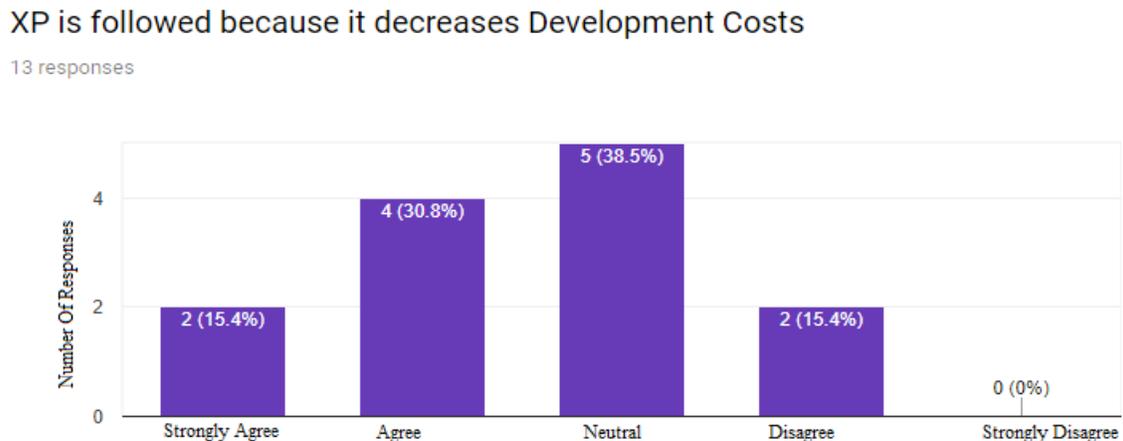We asked the same questions about XP. Figure 10 shows the obtained results.

Figure. 10 Cost management in XP

b) Results and recommendation

The scenario of the cost is quite different than time. Some of them (3 comparisons) will be treated with the same perspective i.e. percentage of disagreement and the remaining two will be treated with the percentage of agreement. The number of responses with disagreement to the first question is same but their percentage is different as shown in Figure 9. This difference is already discussed above. About the question business value, we mean here that which one methodology can give us the better business opportunity. We calculated the business value as a resource for our project. Better the business values, the better will cost management of the project. XP got 3 responses with disagreement in the same criteria as shown in Figure 10, while scrum got 0% response in the same context. The third question of our survey got almost the same responses to that of the first question. Keeping all these evidence in mind, XP got more responses in the disagreement criteria than scrum. This is the conclusion of one scenario.

Let's go for another scenario. Scrum believes more than XP that small budget and limited project resources can cause difficulties with in the project. The ratio of respondents will be considered only when XP got any response in the agreement criteria but the fact is XP has 0% responses in the same criteria with scrum. From this perspective, we conclude that XP is more cost effective than scrum

For the conclusion, we are comparing both scenarios. In the 1ˢᵗ scenario, scrum believes that developmental cost will be decreased if scrum is performed properly. But the 2ⁿᵈ scenario shows that limited project resources cause problems to scrum to be overridden. The scenarios with XP are totally different from the scrum in the same criteria or we can say totally opposite. This balances XP with Scrum. By keeping project size in mind, both methodologies are the need of modern era with different contexts. The recommendation here is that we need to put small budget (e.g. that of XP) to the medium size projects which further implements scrum as a developmental methodology.

4.5 Technological issues

Before addressing this point, technological issues we mean that which methodology has a great percentage to be applied to the projects. If we look at those organizations which implements both scrum and XP to the projects, the percentage of implementation is different for both methods to the projects.

We ask the question, "Scrum is vital methodology within Agile software development methods that are applied to what percentage of projects". Figure 11 shows the obtained result.
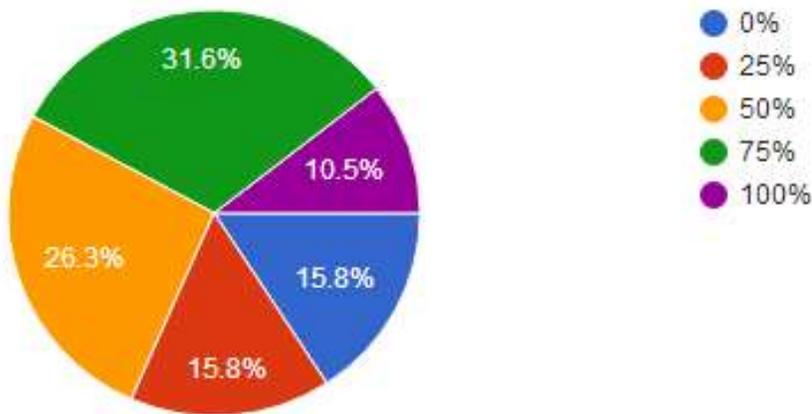

Figure. 11 Technological issues in Scrum

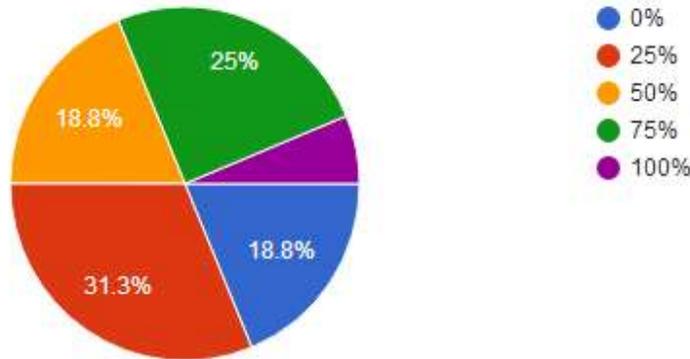The same question is asked about XP, and Fig 4.12 is the obtained result.

Figure. 12 Technological issues in XP

4.5.1 Results and recommendation

Comparing both, scrum has more responses to the higher percentage than XP as shown in Figure 11 & Figure 12. If we look at the trends of both methods, we can ignore the difference between the numbers of responses to both questions. The respondent percentage to the scrum in the higher criteria is more than XP. In the lower criteria scrum is also trending than XP. In the middle, XP is trending more than scrum with the high percentage but it cannot equate the percentage of the scrum in the higher criteria. This concludes that scrum is trending more than XP in the projects.

4.6 Rework issues

Investigating the rework issue of both methods with two aspects, which one reduces rework (examine the percentage of responses) and what is the percentage of reducing rework?

For scrum, we ask two simple questions from our respondents, "Scrum reduces rework", and "Scrum reduces re-workup to". The numbers of respondents to both questions are same. Figure 13 shows the obtained results.
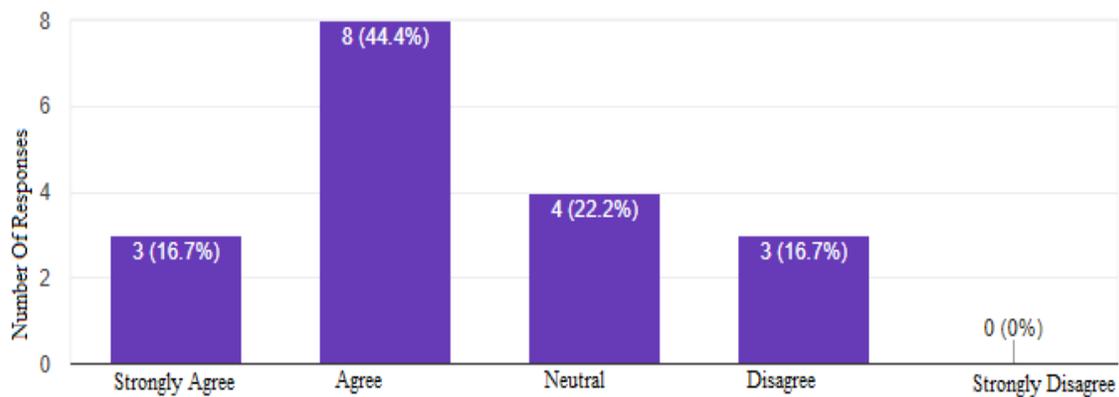

Figure. 13 Rework in Scrum

For XP, we ask the same questions. The numbers of respondents to both questions are same. Figure 14 shows the obtained results.
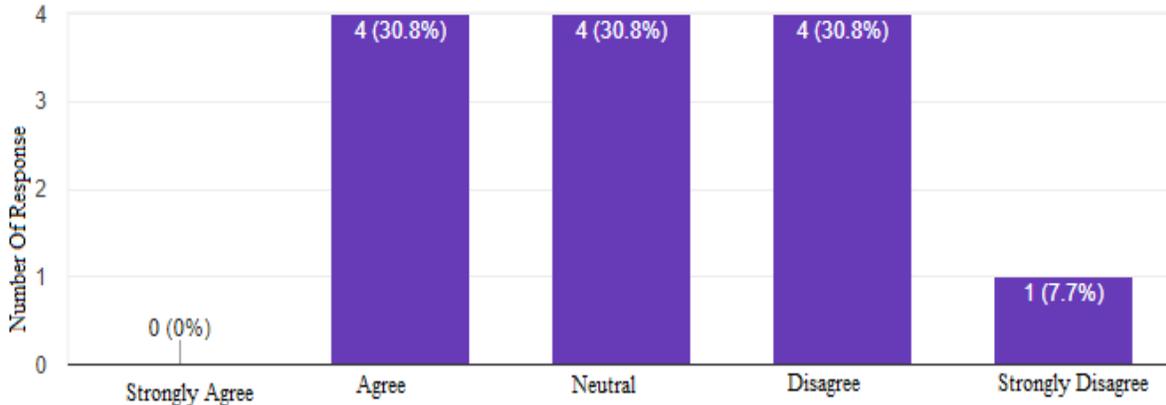
Figure. 14 Rework in XP

4.6.1 Results and recommendation

Number of disagreement in the response of both methods is different. Scrum believes that it can reduce rework more efficiently than XP as shown in Figure 13. Although XP has also some responses in the agreement criteria as shown in Figure 14 but the trend is quite opposite to that of scrum. Scrum is trending more positively than XP which concludes that scrum reduces rework more than XP.

Now let us investigate the percentage of reduction of rework. In the very upper criteria XP leads scrum but at the following criteria, scrum is trending far away from XP. At the lower criteria of 40% and 20%, the XP is again in the leading position than scrum. In this circumstance, the XP is in a tight position with scrum. If XP got more responses on the positive side of the first question, then the scenario will be changed dramatically. But for this, we conclude that scrum reduces rework more than XP.

4.7 Risk issues

The risk is associated everywhere with a project with different aspects. The risk may be due to time, cost, failure or any other project resource. Agile methods reduce these sorts of risks. We are going to investigate scrum and XP to identify that which one method reduces risk more.

For Scrum, we ask simple questions, "If the scrum is performed properly, it results in less risk", "Scrum methodology signifies the success or failure of software project", and "What is the impact of Scrum in term of software project success". All these questions have the same meaning to us and Figure 15 shows the obtained results.
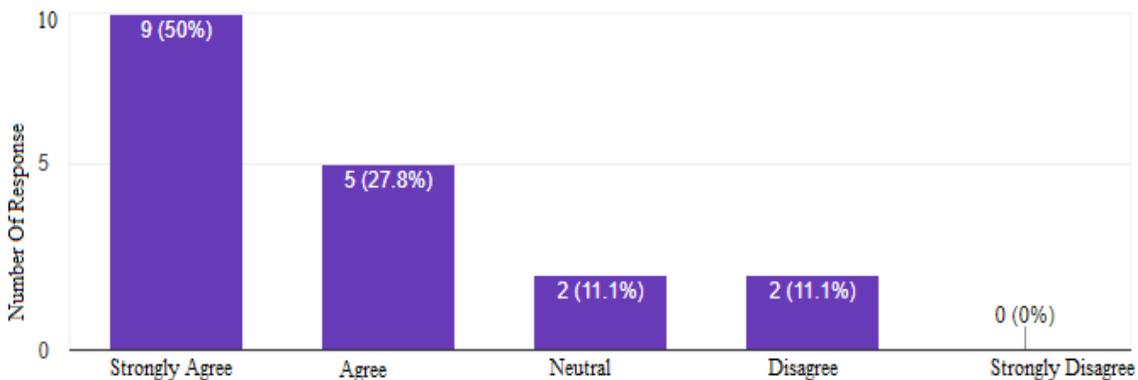

Figure. 15 Risk in Scrum

For XP, we ask the same questions. All these questions have the same meaning to us. Figure 16 shows the obtained result.
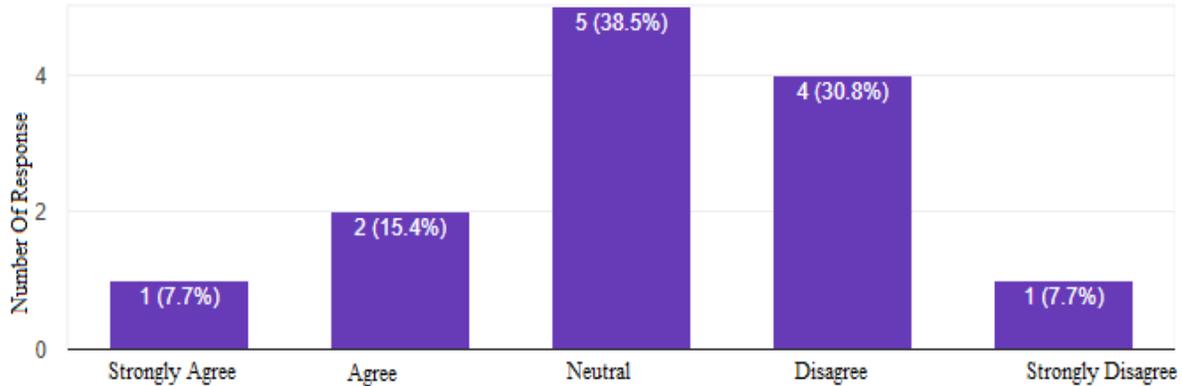

Figure. 16 Risk in XP

4.7.1. Results and recommendation

Addressing the 1st question, Figure 15 and 16, the number and percentage of respondents, in the positive side to the first question of scrum, is far more than that of XP.

For the 2nd question, the scenario is changed. The difference in the percentage is due to the number of respondents but the trend of both is same. Or we can say XP is leading Scrum because XP has a response in the strongly agreed criteria.

For the 3rd question, the scenario is more interesting. In the upper criteria of 80%, XP is leading scrum. In the very next criteria of 60% scrum is leading XP. In 40% criteria, the XP leads scrum again. And in the very lower criteria, the scrum again leads XP. We will go with the very low criteria of 20%. It is because although the numbers of respondents are different the trends show that impact of scrum in the project success is less than XP.

The last two scenarios are in the favor of XP but the 1st scenario is against XP. Here we are going to explore the nature of the questions. If we examine and have a deep look at the questions, the question associated with the 1st scenario is very straight. But the other two questions cover the over all aspects of the project success and failure. We put these two in different criteria than the 1st question. This concludes us that scrum mitigates risk more than XP. The recommendation is that risk management of scrum need to apply on XP.

4.8 Project validation and verifications issues

Validation means, do right things. And verification we mean, do things right. Both of the terminologies, used in software engineering, ensure the quality of the software product. Verification is also done before the validation. We are going to investigate that which one of both these methods can verify and validate product more efficiently.

For scrum, we ask simple questions like, "How much scrum is beneficial in software project validation" and "How much scrum is beneficial in software project verification". The results are shown in Figure 17a and 17b.
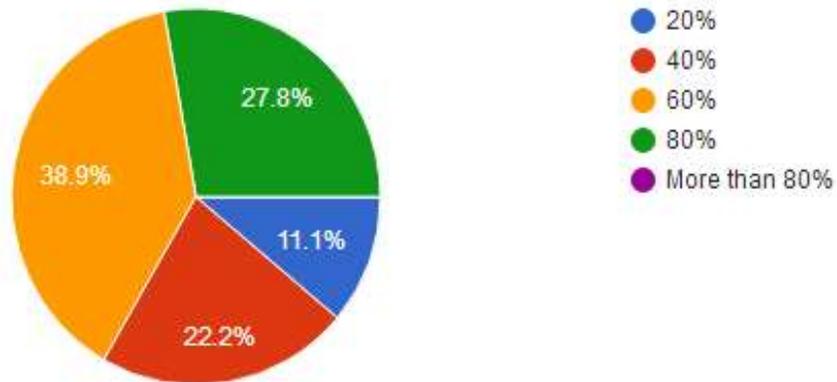
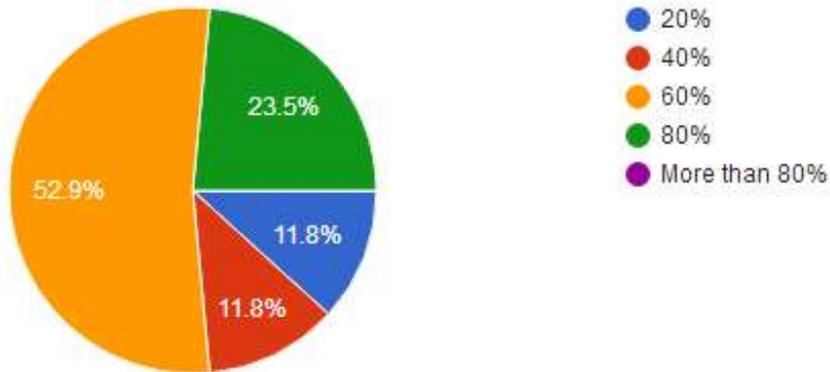**Figure. 17a** Validation and Verification in Scrum

Figure. 17b Validation and verification in scrum

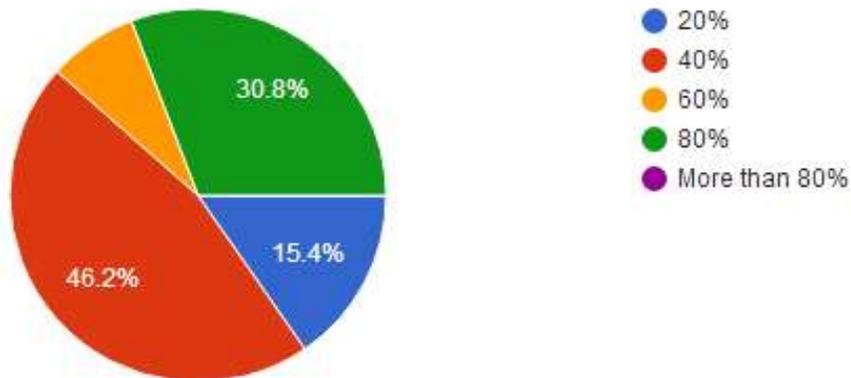For XP, the same question is asked and the results are shown in Figure 18a and 18b.
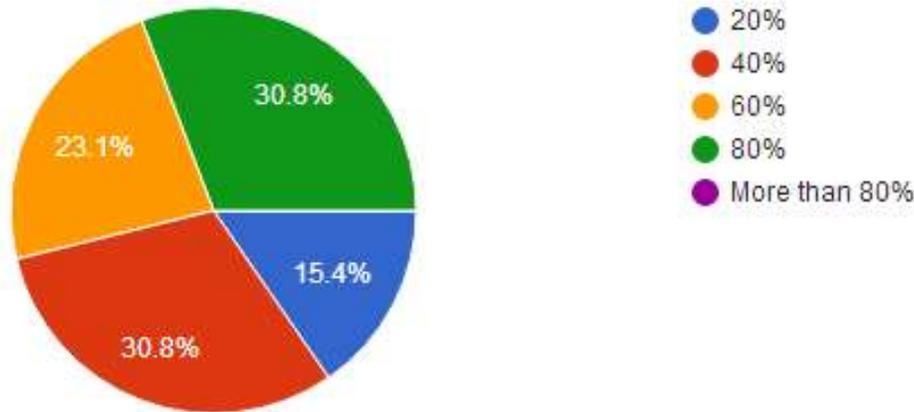

Figure. 18a Validation and verification in XP

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Figure. 18b Validation and verification in XP

4.8.1 Results and recommendation

First, we are going to compare the results for project validation. XP in the highest category (80%) (Figure. 18a) leading scrum in the same category. But in the very next category of 60% (Figure 17a), the scrum leads XP with the high ratio. In 40% category, XP leads again over scrum. At the lower category, both are almost equal. Both the methods can equal each other when we talk about the number of responses for each method. Respondents to scrum are more than that of XP. For that reason, we cannot say clearly that XP is more helpful in project validation. For this case, we will prefer that both scrum and XP are equal in software project validation and both have a high impact on the project validation.

In the software project verification, the scrum got the highest percentage in the higher categories of 80% and 60% as shown in Figure 17b. XP lost the competition in the same category as shown in Figure 18b. This concludes that scrum has the high impact on the software project verification than XP.

4.9 Customer satisfaction

Projects success is highly dependent on customer satisfaction. Agile focuses on customer satisfaction more than TSD. To address the issue here means that we are going to find out which one method has the highest rate of customer satisfaction.

For scrum, we ask simple questions, "If scrum is performed properly, it results in customer satisfaction", and "Scrum makes the development process easy with respect to customer satisfaction". The responses to both the questions are same. Obtained results are given in Figure 19.
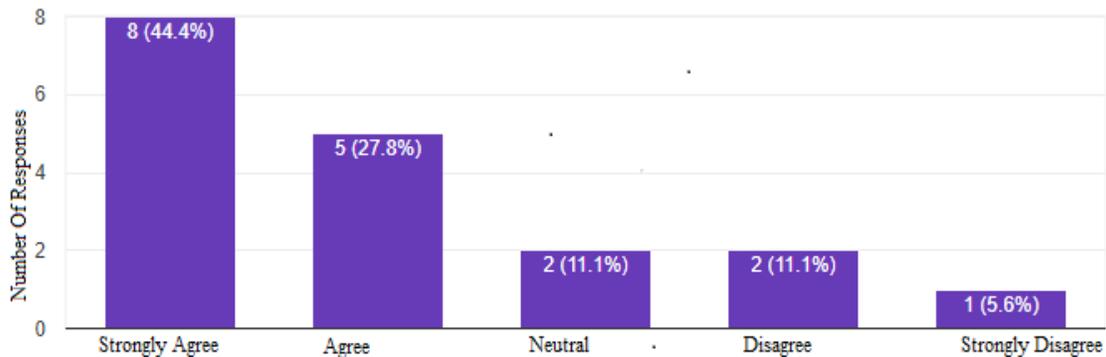

Figure. 19 Customer satisfaction in scrum

For XP, we ask the same questions. The responses to both the questions are same. Respondents' results are shown in Figure 20.
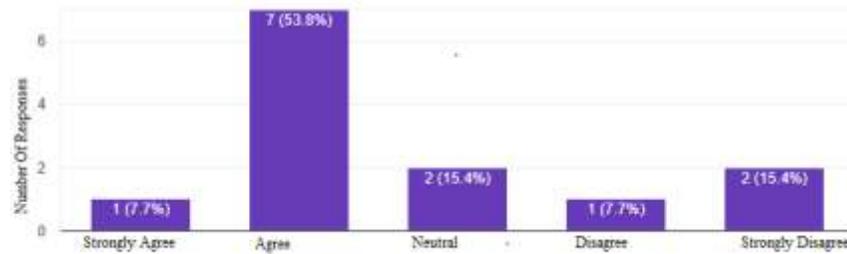
Figure. 20 Customer satisfaction in XP

4.9.1 Results and recommendation

The nature of both questions is same. The number of respondents to both questions of each method is same. If we compare 1st questions of both methods, in Figure 19 scrum is trending to the positive side more than XP in Figure 20. For the 2nd question, scrum has no response on the negative side and XP has. Thus, stakeholders who are following scrum are more satisfied than XP.

4.10 Decision-making process

Decision-making about the system is vital. If clients have time to take some sort of decisions about the system, the system that we are going to develop will have high success rate. As agile is highly customer centered, thus the decision-making process enables the customers to make good decisions about the system. The purpose of this comparison is to identify that what methodology consists of the good decision-making process.

For scrum, we ask the question, "Does the scrum help stakeholders to make good decisions for the system?" The results are shown in Figure 21 and 22.
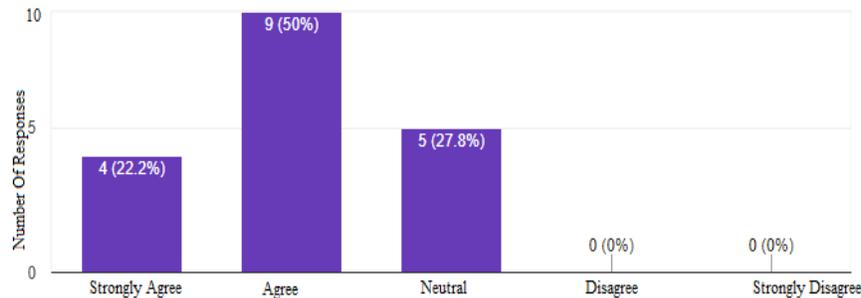

Figure. 21 Decision-making in Scrum

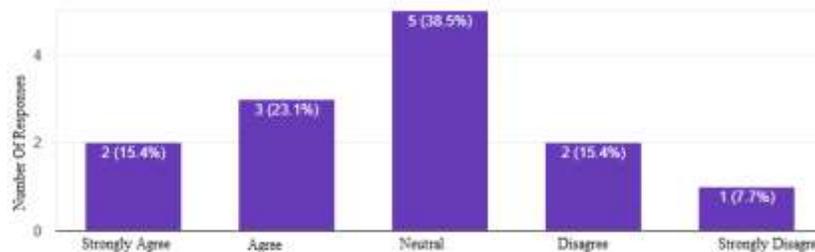For XP, we ask the same question. The results are shown in Figure 22.

Figure. 22 Decision-making in XP

4.10.1 Results and recommendation

Comparing these both evidences, scrum has the high percentage in the positive aspect than XP. XP got more disagreement responses in the same category as shown in Figure 22. This concludes that scrum has a good decision-

making power than XP. It is because it provides some extra time to the clients to discuss the issues about the system developers.

5. RESULTS

This section presents the results of the above discussion. The research questions are answered and a set of guidelines are presented in this paper.

5.1 Similarities and differences between scrum and XP

From the above discussion, we found some of the following similarities between scrum and XP.

1. The software developers have high percentage of practicing both scrum and XP
2. Both scrum and XP make the development process easy with respect to change management.
3. Both scrum and XP are equal in software project validation and both have high impact on the project validation.

The differences that we have found in scrum and XP are listed here:

1. Scrum is more acceptable in Pakistan than XP.
2. Communication between the stakeholders in scrum makes the scrum more efficient than XP.
3. Time management in scrum has high success rate than XP. Both are implemented in different size projects. XP time management has validity in small projects while scrum has validity in medium size projects. Although scrum requires more time than XP, it is only because of the project size.
4. Scrum believes more than XP that small budget and limited project resources can cause difficulties with in the project.
5. Scrum believes that developmental cost will be decreased if scrum is performed properly
6. Scrum is trending more than XP in the projects within Pakistan
7. Scrum mitigates risk more than XP.
8. Stakeholders those are following scrum are more satisfy than XP.
9. Decision-making process of Scrum is quite successful than XP. It is because it provides some extra time to the clients to discuss the issues about the system developers.
10. Scrum reduces rework more than XP.
11. Scrum has high impact on the software project verification than XP

Table 1 summaries the results.

Table. 1 Summarized discussion

	Scrum	XP
Most acceptable in Pakistan	√	×
Communication between stakeholders	√	×
Time management	√	×
Customer Satisfaction	√	×
Small Recourses effects	√	×
Cost	High (if performed properly then low)	Low
Software Project Verification	√	×
Software Project Validation	√	√
Trends in projects	√	×
Practiced equally By	Software Developer and other stakeholders	Software developers and other stakeholders
Risk mitigation power	More	Less
Stakeholders satisfaction	√	×
Decision making process success rate	High	Low
Rework reduction	More	Low

5.2 Future enhancement

Scrum is the most successful method in Pakistani industry. However, XP is mostly acceptable for the quick development of small projects. Scrum takes a longer time to develop a medium size project. Small project resources produce difficulties for the scrum. On the other hand, high risk is associated with XP. These features of one another are applied against each other to get hybrid of scrum and XP and is known as SuXP Hybrid. SuXP will cover medium projects in the short span of time and with low recourses, low amount of risk will be associated, customer satisfaction will be high and most importantly engineering techniques should be applied with a self-organized team to increase the success rate of medium size software projects. The first three points are taken from XP while the other three points are taken from the scrum. It is because these six points can overcome all those problems that we have discussed above for the Pakistani software industry. The combination of both is the SuXP hybrid. The architecture of SuXP is given in Figure 23.
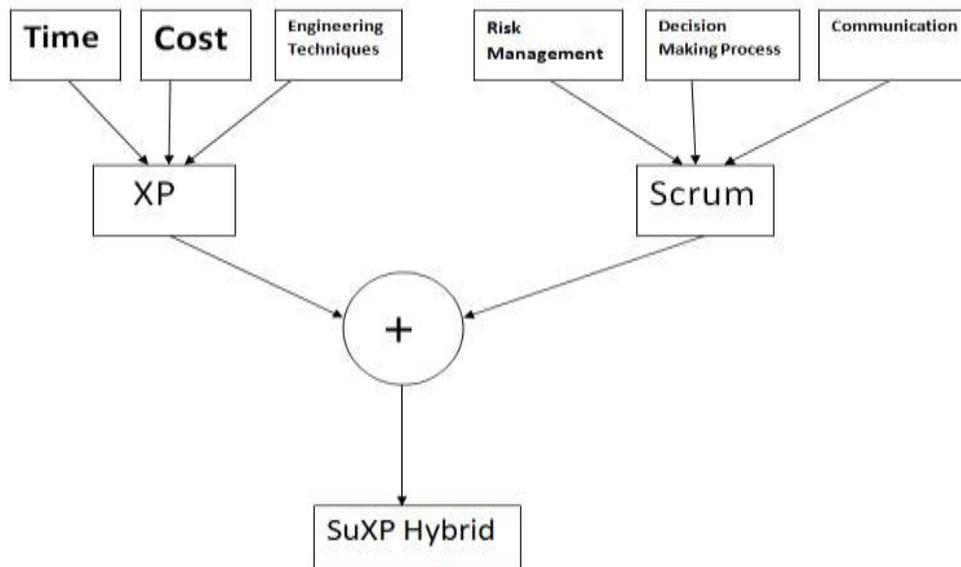

Figure. 23 SuXP architecture

6. CONCLUSION

Software industry of Pakistan is facing many problems in order to know the importance of agile development. XP is trending all over the world but Pakistani industry is unable to get results out of it. Scrum is the most acceptable method among all agile methodologies in Pakistan and organizations are ready to maximize their outputs from scrum development. Scrum and XP are quite different methods but still, they both have some common features which are used against each other to get a hybrid methodology and it is hoped that SuXP hybrid will solve some of the problems within Pakistani environment. This survey covers some aspects of scrum and XP but both frameworks are quite large. Some other aspects are missed like iteration enhancement. For the future, it is suggested to cover some different aspects of both methods. Develop a case study on the implementation SuXP in small as well as medium size projects and develop a report.

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REFERENCES

1.   Larman, C. and V.R. Basili, *Iterative and incremental developments. a brief history.* Computer, 2003. 36(6): p. 47-56.

2.   Lindvall, M., et al., *Empirical findings in agile methods.* Extreme Programming and Agile Methods—XP/Agile Universe 2002, 2002: p. 81-92.

3.   Fowler, M. and J. Highsmith, *The Agile Manifesto. August 2001.* Software Development, The life cycle starts here.

4.   Ahmad, G., T.R. Soomro, and M.N. Brohi, *Agile Methodologies: Comparative Study and Future Direction.* European Academic Research, 2014. 1(11): p. 3826-3841.

5.   Fuster, J.E., *Modern Software Project Management.* 2010, University Politecnica De Valencia.

6.   Rosenberg, D. and M. Stephens, *Extreme programming refactored: the case against XP.* 2008: Apress.

7.   Beck, K. *Manifesto for Agile Software Development.* 2001 [cited 2017 17/06/2017]; Available from: http://agilemanifesto.org/.

8.   Faisal Shafique Butt, Z.A., Rabia Mukhtar, Daud Abdullah, Khalid Ibrahim and Riaz Ahmed, *Agile methodologies, their impact on software development and implementation: Evidence from Pakistan.* Canadian Journal of Pure & Applied Sciences, 2015. 9(3): p. 3643-3653.

9.   Henry, J. and S. Henry. *Quantitative assessment of the software maintenance process and requirements volatility.* in *Proceedings of the 1993 ACM conference on Computer science.* 1993: ACM.

10.   Alliance, S., *What is Scrum? An Agile Framework for Completing Complex Projects-Scrum Alliance.* Scrum Alliance. Available at: https://www. scrumalliance. org, 2016.

11.   Verheyen, G. *Scrum: Framework, not methodology.* 2013 [cited 2017 06/20/2017]; Available from: https://guntherverheyen.com/2013/03/21/scrum-framework-not-methodology/.

12.   Nonkaka, I. and H. Takeucho, *The Knowledge Creating Company Oxford University Pres.* 1995, NY.

13.   Rebolledo-Mendez, G. *Designing for Collaborative as well as Indivualised Environments.* in *Human Centred Technology Workshop 2006* University of Sussex Falmer: University of Sussex.

14.   USFCA. *Extreme Programming.* [cited 2017 23/07/2017]; Available from: http://www.cs.usfca.edu/~parrt/course/601/lectures/xp.html.

15.   Cockburn, A., *Agile software development.* Vol. 177. 2002: Addison-Wesley Boston.

16.   Highsmith, J., *Adaptive software development.* Dorset House, 2000.

17.   Alliance, A., *Agile manifesto.* Online at http://www. agilemanifesto. org, 2001. 6(1).

18.   Ali, M.A., *Survey on the state of agile practices implementation in Pakistan.* International Journal of Information and Communication Technology Research, 2012. 2(4).

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