



Agile Development Methodology: Impact on Project Cost and Time

Kashif Nawaz

kashif.nawaz@ptclgroup.com

Received: 14 Nov 2024; Received in revised form: 12 Dec 2024; Accepted: 19 Dec 2024; Available online: 27 Dec 2024

Abstract— *The study investigates the impact of cost and time based on chosen development methodology specifically agile software development. Agile software development is being used widely in maximum IT companies. The sole purpose of this research is to study the impact of cost and time on software projects which were developed using agile frameworks. The concept of the study uses quantitative descriptive approach in which all respondents were given a survey of closed-ended questions to determine the impact of cost and time on software projects using agile software development. The gathered information was statistically analyzed using Statistical Package for the Social Sciences (SPSS) tool. Validity test was verified by panel of experts, and reliability was checked by Cronbach's alpha of internal consistency. A number of analyses were performed on the data including normality testing, correlations and regression analysis.*

Keywords— *Agile Software Development, Impact of Cost, Time impact, Software development cost and time impact.*

I. INTRODUCTION

Agile software development has played an important role in almost every business area since the internet dawn. As the consumer's desire for immediacy and convenience grows, companies are increasingly being asked to integrate and develop their web-based services into their products. As a result, more resources are devoted to developing profitable software that meets consumer demands. Businesses want to maximize profits, so they need efficient resource allocation to keep costs down. This is achieved by adopting a process model that maximizes the conversion of resources into quality goods. Agile software development is a new paradigm aimed at reducing risk and cost of production. It is based on iterative development and constant feedback from all stakeholders throughout the development cycle. Moving from a typical waterfall process model to an agile process model reduces lead times and increases team morale and productivity, reducing the risks associated with large software programmer development. My research shows that companies across a wide range of industries can benefit from incorporating some degree of agility into their development processes. In recent years, the size and functionality of software have increased significantly. Cost and time are the major factors

in software development cycle, cost estimation must be completed before the development cycle begins and deadlines or estimated completion time must be defined before the development starts. Both factors help you correctly estimate each project and get the right price and delivery time. The vibrant and dynamic nature of ASD makes starting product development using agile methodologies a daunting task. Therefore, such a development model requires accurate cost estimates to match deadlines and estimates while maintaining the highest software quality. This report provides a systematic impact of ASD's on project cost and time and helps an agile user to understand the impact of these factors while choosing ASD for his project.

II. BACKGROUND

A process model is required to set the timeline for software project deliverables and to ensure that all members of the development team, from managers to engineers to end users, understand workflow expectations. Organizations are beginning to realize the inherent limitations of the long-used waterfall approach. A linear schedule for developing requirements, implementing all features, and testing does

not adapt well to changing customer requirements, putting the project at significant risk. My research examines the impact of agile approaches on these risks and costs. Agile uses an iterative development methodology, where features are developed in 2–4-week increments. As a result, all three major components of software development are repeated during the development cycle. Small features are generated every few weeks and can be easily modified, allowing for changing user requirements. The result is lower risk than the waterfall approach and lower capital costs for software projects in agile frameworks. Because this method is highly adaptable and responsive to continuous input, the product almost perfectly matches consumer expectations, resulting in greater satisfaction and demand, as well as higher profitability. However, only good implementation of agile approaches, or a good degree of agility, can lead to such low software development costs. My research examines the pros and cons of using agile models to assess cost and time impacts on software projects. We begin by examining the broad expert consensus on the limitations of both traditional and agile methodologies and the benefits of agile process models. Then, we explore the main areas of cost, quality and customer satisfaction that are impacted when moving from a traditional method to an agile one.

The term agile methodology refers to processes that are developed and tested throughout the software development lifecycle of a project. In contrast to the waterfall approach, the agile style of software testing runs both the development and testing processes simultaneously. Agile refers to a software development methodology that emphasizes customer satisfaction, team productivity, continuous planning, and incremental deliverables, rather than aiming to deliver everything at once at the end.

Agile focuses on keeping processes lean and delivering a minimum viable product (MVP) that goes through multiple iterations before being finalized. Feedback is continuously captured and incorporated, resulting in a more dynamic process where everyone is working towards a common goal.

PURPOSE

Determining how long and how much it will take to deliver a new software product is one of the most difficult tasks in software development. Should it be that challenging? The answer is a little more complex and difficult.

Estimating software expenses is tough by nature, and humans are notoriously terrible at forecasting absolute outcomes. There are no two projects alike; each has its own set of goals and a unique set of parameters that define its existence. What appears to be a simple problem on the surface is sometimes considerably more difficult or

technically difficult to accomplish in practice. And, without a doubt, there will be 'unknowns' with the project that will only be discovered when they occur. Furthermore, whether you're a consumer, a developer, or a user, no two people are same. We arrive with our own set of information, experiences, values, expectations, risk aversion, and adaptability. Senior engineers are accustomed to writing high-quality software; but, building amazing software solutions may be a much more challenging task for all parties involved.

This study aims to examine the impact of the cost and time on project delivery using agile process model.

PROBLEM STATEMENT

Agile methodology is being used extensively in various organizations, but most of them face problem that how long and how much cost it will take to deliver the project, this study was aimed to explore the critical factors that impact project time and cost using the agile methodology.

SCOPE OF WORK

In order to find out the factors that impact project time and cost using agile methodology. The study is limited to software projects and in terms of methodology it is limited to agile software development. We picked 30 samples from IT industry of Islamabad and hence this study is covering only companies working in Islamabad. Companies selected for research also work for international clients and have more than 100 employees.

SIGNIFICANCE OF THE STUDY

The critical factors identified in this research would be helpful for the other companies working on agile methodology to keep them in mind while checking the impact of cost and time using agile methodology for any project. They will likely face less issues in execution of project if they take care of the identified factors and conclusions drawn in this study.

RESEARCH OBJECTIVES

Following are the main objectives this research:

- Evaluate if team capability has impact on cost and time of project.
- To evaluate customer feedback and requirements gathering as a major impact on project cost and time.
- To measure the impact of agile methodology on cost.
- To measure the impact of agile methodology on time.

RESEARCH QUESTIONS

RQ1 Does team capability impact on cost and time of project?

RQ2 Are the customer feedback and requirements gathering as a major impact on project cost and time?

RQ3 Project deliverables with equal and defined deadlines is more valuable to accomplish the project on time and at defined cost?

RQ4 Execution of agile methodology has a direct impact on project cost and time?

CLASSIFICATION

Purpose of Research	Descriptive
Research Paradigm	Ontology => Objective, and Epistemology => Positivist
Research Method & Techniques/Data Gathering	Quantitative and Survey research (closed-end Questionnaires)
Study Population	Telecommunication Industry
Sampling Frame	Executive, Project Manager, Project coordinator, Member of the project team and users
Minimum Sample Size	30 individuals are selected from the population of 3 IT companies.
Sampling Technique	Simple Random sampling
Data Analysis Approaches	Deductive =>Exploring Relationships, and Comparing groups => ANOVA

Table 1.1: Classification of Research

DATA COLLECTION

A few of the effective methods to gather data from a large number of population and then apply different random sampling techniques upon it to extract out the desired results. To test the research hypothesis and the research model, data is gathered through 3 IT companies of Islamabad and 30 individuals participated in data collection. Product owners, project managers, scrum master, team leads and managers with project costing knowledge and those who are responsible for project timelines have been consulted and their views has been gathered through the questionnaires. This survey was conducted on a voluntary basis with no undue pressure. All the target respondents were given a standardized questionnaire as shown below:

Sr. No	AGILE SOFTWARE DEVELOPMENT: IMPACT ON PROJECT COST AND TIME	Level of Significance				
		1	2	3	4	5
1.1	Team Productivity					
1.1.1	customer realized the delivered value in each iteration and release					
1.1.2	Projects are motivating the team to do task with whole heartedly.					
1.1.3	Each member of team has domain knowledge of product					
1.1.4	Work place is suitable for creative work, e.g., windows, natural light, size of room and desk?					
1.2	Customer Satisfaction					
1.2.1	Was the project planning complete from beginning to end?					
1.2.2	Did the project manager understand how much time the project required?					
1.2.3	The project completed under budget?					
1.2.4	Customers actively participate in sprint planning?					
1.2.5	Customer gives positive feedback on iterations and release?					
1.3	On time Delivery					
1.3.1	Did the project finish in the stated timeframe?					
1.3.2	Customer relationship in agile process effect delivering on time					
1.3.3	Teamwork in organizational dimension effect delivering on time.					
1.4	Management Style					
1.4.1	Scrum master/Project manager actively calls for daily/scrums meetings.					
1.4.2	Line manager is cooperative in terms of task understanding and communication.					
1.4.3	Project scope is clear from the beginning of the project.					
1.4.4	Management commitments in agile process effect total estimated cost and time					
1.5	Project Cost and Time					
1.5.1	Agile software development is directly impacting the projects to be under budget and on time.					
1.5.2	Budgets are controlled in Agile software development.					
1.5.3	Project deadlines are mostly met in agile software development.					
1.5.4	Agile software development is helpful to mitigate the risks that cause delays in software projects.					
1.5.5	Agile Software development is helpful to mitigate the risks that cause extra cost on project.					

DATA ANALYSIS

Most data were received back from the respondents via online questionnaires as most IT staff prefer to use their screens scrum and keep in the comfort of their work environment so researcher also preferred this way to get the actual and real results. Analytical study on collected data were performed using the Statistical Package for the Social Scientists (SPSS). A quantitative approach enables an investigator to investigate the relationship between variables. As there were a number of variables, both dependent and independent, in this study.

STEPS IN QUESTIONNAIRE DESIGN

According to Dr. R. Venkitachalam’s “” and Linda Del Greco, Walop W.Richard H McCarthy.

The steps in questionnaire design are as below:

Step 1: Background;

- (a) Purpose and goal/objectives in Research questions, hypothesis;
- (b)Target audience / population sample.

Step 2: Conceptualization;

- (a) Generate statements/ questions items i.e. variables; Independent Variables (IV), Dependent Variables (DV);

- (b) Knowledge, attitude, perception, opinion, facts, behavior

Step 3: Format & Data Analysis;

- (a) Appropriate scales of measurement.
- (b) Data Analysis
- (c) Questionnaire format.

Step 4: Validity;

- (a) *Panel of experts*
- (b) Readability tests
- (c) IRB (Institutional Review Board)
- (d) Field Test
- (e) Revisions Readability Test.

Step 5: Reliability;

- (a) Pilot Test reliability.
- (b) Run Alpha, revisions, Re-Run Alpha.
- (c) Instrument ready for mailing.

LIMITATIONS OF THE STUDY

The study has also some limitations which are important to mention at this stage. First, the study focuses only on IT market of Islamabad. Second, the study only emphasizes on industry of Pakistan. Therefore, the dynamics of Agile impact in global organizations are not the part of this study.

THEORETICAL FRAMEWORK

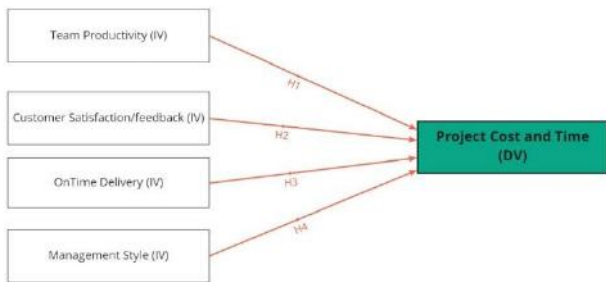


Figure 1.1: Diagrammatic Depiction of Independent and dependent Variables

III. LITERATURE REVIEW

The purpose of this section is to examine the potential impacts that Agile software development can have on time and cost, with a specific focus on major contributions that are discussed in the available literature.

1.1. LITERATURE REVIEW

- AGILE SOFTWARE DEVELOPMENT

Agile refers to software development methodologies that emphasis incremental delivery, team communication, continuous planning, and continuous learning rather than attempting to provide everything at once towards the end. Agile promotes keeping processes lean and developing minimal viable products (MVPs) that go through several iterations before being complete. Feedback is continuously collected and incorporated, resulting in a much more dynamic process in which everyone is working towards a common objective.

- SHORT HISTORY OF AGILE

Agile software development is a methodology that was first proposed in the early 1990s. It was created as an alternative to the traditional waterfall model of software development. In agile, software is developed in short cycles, or sprints, and each sprint focuses on a specific set of features. This allows for more flexibility and iteration than the waterfall model. Agile has become increasingly popular in recent years, and many organizations have adopted it as their primary method of software development.

- AGILE IS MINDSET

Therefore, Agile is a mentality based on the ideals and principles of the Agile Manifesto. These beliefs and principles show how to produce and adapt to change, as well as how to deal with uncertainty. The Agile Manifesto's opening phrase encompasses the whole concept: "By doing it and helping others do it, we are finding new ways of building software." When faced with ambiguity, try something you believe could work, obtain feedback, and make adjustments as needed. When you're doing this, keep the values and principles in mind. Allow your context to inform the frameworks, methods, and approaches you apply to engage with your team and provide value to your customers.

- AGILE SOFTWARE DEVELOPMENT MODEL

Every project should be handled differently, according to the Agile model, and current techniques should be adapted to best meet the project objectives. To provide particular features for a release, tasks are split into time boxes (short time spans) in Agile.

The process is iterative, with each iteration delivering a functional software build. In terms of features, each build is incremental; the final version contains all of the features required by the customer.

Here illustration of the Agile Process Model:

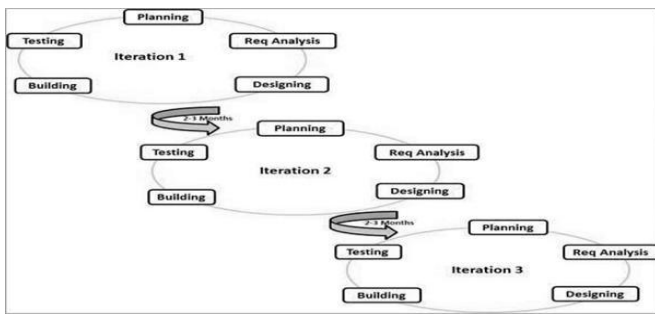


Figure 2.1: Agile Software Development Model

Because of its flexibility and adaptability, the Agile thinking process began early in software development and grew in popularity over time. Rational Unified Process (1994), Scrum (1995), Crystal Clear, Extreme Programming (1996), Adaptive Software Development, Feature Driven Development, and Dynamic Systems Development Method (DSDM) are some of the most prominent agile techniques (1995). Following the publication of the Agile Manifesto in 2001, these are now referred to as Agile Methodologies.

- AGILE SOFTWARE DEVELOPMENT PROCESS USE

There are several common software development methodologies, such as Scrum, Extreme Programming, and Feature-Driven Development (FDD). The processes involved in these methodologies are planning meetings, test-driven development, pair programming, stand up meetings and sprints.

With Agile, people and the tasks their team does are the focus of software development. An important aspect of the Agile software development is the teams (self-organizing cross-functional) collaborating to finish a project. For example, those development teams would create their own plans to complete a task based on using best practices for their context while they keep in mind their potential failure and crisis management should they encounter an issue or problem. Those self-organizing teams should also work with other members who have different expertise as needs arise. Managers will still play a role in an agile environment; however, managers aid in implementing change within an agile project by creating a group that possesses or acquires skill sets to tackle projects successfully.

- SCRUM

It's a technique used in agile software development. Scrum is named after the rugby strategy and believes it's more beneficial to work in small teams than large ones. Within

this method there are three categories, with their responsibilities as follows:



Figure 2.2: Scrum Method

- a) Scrum Master: The Scrum Master is in charge of organizing the team, sprint meetings, and removing roadblocks to progress.
- b) Product Owner: The Product Owner is in charge of delivering functionality at each iteration and building the product backlog.
- c) Scrum Meeting: A scrum meeting is a short, daily meeting where team members discuss what they have accomplished since the last meeting and what they plan to do before the next one. This type of meeting helps ensure that everyone is on the same page and that tasks are being completed in a timely manner.
- d) Product Backlog: It is an agile artifact that captures what needs to be delivered in order to achieve the desired outcome. The product backlog items are ordered by priority, with the most important items at the top. As new items are added, they are placed in priority order based on their impact on the business.

- PROCESS FLOW OF SCRUM

- a) The team works on the set sprint backlog
- b) The team checks for daily work
- c) At the end of the sprint, the team provides product functionality
- d) The product backlog is a list where all information are included to achieve the final-product

BENEFITS OF USING THE AGILE METHODOLOGY

Agile methodology is a set of practices and methods that encourage collaboration and flexibility in the development process. It has become popular in recent years because it helps to improve communication, speed up project completion, and reduce risks. Following are some of the benefits of using agile methodology in your project.

ON TIME DELIVERY

Organizations that adopt agile methodology achieve a number of benefits, including on-time delivery. The traditional waterfall development process often results in projects taking longer than necessary to complete. This is because the traditional process involves a long and detailed planning phase followed by a long and detailed development phase. During the planning phase, developers are required to compile a detailed list of features and specs, which can be difficult to change once the project has begun. This can also lead to delays in the development phase, as developers need time to incorporate all the proposed changes into the project.

Agile methodology, on the other hand, focuses on completing projects quickly and efficiently. This is done by breaking projects down into small, manageable pieces and building them until they are completed. This approach allows for more flexibility in project planning and development, which leads to quicker completion times. In addition, agile methods often result in improved quality because they allow for more rapid feedback and iteration between stakeholders.

SUPERIOR QUALITY PRODUCT

Agile methodology is more than just a software development methodology. It's a way of life, one that stresses collaboration and communication, focus on customer needs and constant learning. The benefits of embracing agile are clear: superior quality products that are delivered on time and on budget. With an agile process in place, communication between team members is key. This allows for seamless integration of new features and updates into the product, resulting in a better user experience and less rework. An agile process allows for quicker development times, leading to a faster time to market. This can be essential in the ever-competitive world of technology.

By implementing an agile process, you can reduce costs associated with developing software. The streamlined workflow will help keep your team organized and coordinated, allowing for more accurate estimates and fewer missteps. An agile process leads to higher quality products by encouraging teams to work quickly and efficiently without compromising on quality. By minimizing errors from the start, you can ensure that your final product is of the highest caliber.

CUSTOMER SATISFACTION

The agile methodology is a process that helps organizations to be more responsive to customers and improve their overall customer satisfaction. By using the agile methodology, organizations can increase their ability

to respond quickly to changes in the marketplace and provide better service to their customers.

Organizations that use the agile methodology often find that they are able to improve their customer satisfaction ratings. This is because agile methods help organizations to become more responsive to customer needs, and this responsiveness can lead to improved satisfaction levels. In addition, agile methods help Organizations reduce the amount of time needed to deliver products or services, which can also lead to increased customer satisfaction.

Overall, the agile methodology is a useful way for organizations to improve their customer satisfaction ratings.

BETTER CONTROL

Agile methods allow for better control over project deadlines and product quality. By working incrementally and continuously testing, agile techniques help developers to find and fix errors early, saving time and money. Furthermore, agile methods promote collaboration among team members, which leads to a better understanding of the project and an increased ability to meet deadlines. With everyone working together in an open environment, the project can move more quickly and efficiently. Overall, agile techniques offer many advantages for both the developers and the organization as a whole - making it a popular choice for projects of all types.

IMPROVED PROJECT PREDICTABILITY

The agile methodology has been shown to be an effective tool for improving project predictability. This allows for better planning and communication, which in turn leads to a more efficient and successful project. One of the key benefits of using the agile methodology is that it helps to overcome the "waterfall model" mentality. The waterfall model is a process where a project is planned and executed in a sequential manner, with each step requiring prior completion of the previous step. However, this model can be inefficient because it can lead to delays in project milestones.

By using the agile methodology, projects are able to move faster and more efficiently through the stages of development. This allows for a more accurate prediction of when certain tasks will be completed and ultimately leads to a more accurate end product.

REDUCED RISKS

Agile methodologies help to reduce the risks associated with project delivery. This is because they emphasize communication and collaboration between team members, which helps to eliminate misunderstandings and potential conflict. Another benefit of agile methodology is that it allows teams to adapt quickly to changes in the

environment. This means that they are able to respond more effectively to unforeseen challenges and problems.

Overall, agile methods provide a number of advantages that can help organizations achieve their goals faster and with fewer risks.

INCREASED FLEXIBILITY

Agile methodology has been shown to lead to increased flexibility. This is because agile encourages the use of short, iterative cycles that allow for changes to be made quickly and easily. As a result, projects are able to move faster and achieve their objectives more quickly. Furthermore, because agile is incremental, it is less risky and allows for corrections along the way. This methodology also leads to a better understanding of the problem and results in better solutions.

CONTINUOUS IMPROVEMENT

Agile methodologies are designed to help organizations achieve continuous improvement. According to the National Institute of Standards and Technology, "Each iteration of the agile methodology focuses on delivering working software frequently, with a focus on customer satisfaction." This approach encourages teams to continuously assess their work and make necessary changes in order to improve the quality and efficiency of their work.

IV. RESEARCH METHODOLOGY

- INTRODUCTION

In this section, we will be discussing the methodology that we will be using to conduct our research. The variables and their operational description/definitions, research tool applied to examine those variables, hypothetical relationship and its graphical portrayal are also briefly illustrated in the section. Moreover, the method for data collection and the software utilized for the analysis of the collected data are also briefly explained.

- RESEARCH METHODOLOGY PROCESS FLOW

The research work has been carried out in different phases to make it systematic and in a sequence such that desired results could be achieved.

PHASE 1: DEFINE GOAL AND CONDUCT LITERATURE REVIEW

Section one i.e. Introduction amplifies upon defining goal for the research conducted in this research. Section two i.e. Literature Review explains in detail the main theme of the research and research idea giving detail background information. The cardinal purpose of the research is to

study the impact of agile software development on project cost and time. This research carryout detailed analysis of factors impacting cost and time using agile software development approach.

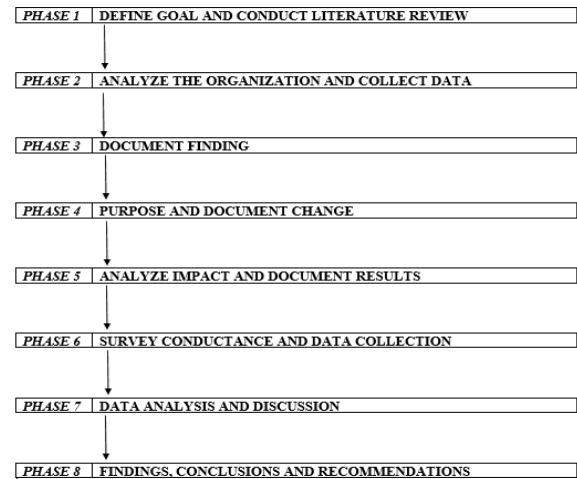


Figure 3.1: Work flow diagram of how the research work was proceeded.

PHASE 2: ANALYZE THE ORGANIZATION AND COLLECT DATA

Depending on the research that has been made during the initial phase, to investigate the impact of software cost and time using agile software development, a research topic was devised in consultation with supervisor and teachers. The finalized research topic is "Agile software development: impact on project cost and time".

PHASE 3: DOCUMENT FINDING

On the basis of finalized research topic " Agile software development: impact on project cost and time ", Firstly the main hub of the knowledge, similar research papers selected for literature review, Secondly, internet resources were searched which came up with relevant articles and the key words of "Agile software development cost and time", "Agile software development", "research methodology", "data analysis" etc. were retrieved and read thoroughly. Section number 2 includes review of almost all relevant literature.

PHASE 4: PURPOSE AND DOCUMENT CHANGE

Problem statement that is highlighted in the Introduction section at section 1.3 was planned, reviewed and finalized with the help of supervisor and IT sector Executives.

- PHASE 5: ANALYZE IMPACT AND DOCUMENT RESULTS

On the basis of the project's research area, targeted entities and the problem statement a questionnaire is developed in

context of impact of cost and time using agile methodology in development of software.

- **PHASE 6: SURVEY CONDUCTANCE AND DATA COLLECTION.**

Source of Primary Data

The population of this study includes employees of Information Sector employees specially managers, team leads, product owners, technical executives and supervisors and those managers from whom some management shares and give opinion of project cost and time. The sample size was found out to be 30 numbers from the Information Technology sector of Islamabad. The respondents were selected through simple random sampling method in which every element has the same probability for being selected for the sample (Kothari, 1990). Thirty questionnaires were distributed in above mentioned respondents.

In total 35 plus survey forms were sent by using sample size techniques and 30 forms were received considered for study. The Survey forms received were recorded and data retrieved was analyzed and discussed according to standard procedures.

- **PHASE 7: DATA ANALYSIS AND DISCUSSION**

This phase incorporates the data collected through survey questionnaire and the results which are the outcome of this survey to yield the inference from test and further hypothesis validation. Different types of analysis such as descriptive analysis, data normality testing, correlations analysis and regression analyses is used to produce the findings. The entire analysis was done using the software SPSS.

- **PHASE 8: FINDINGS, CONCLUSIONS AND RECOMMENDATIONS**

After data analysis and discussions, findings, conclusions of the research and recommendations regarding future research work were drawn and incorporated in section five of this research.

Following hypotheses were formulated for this research study:

Hypothesis 1

H₁: Team capability is an important factor for a successful agile software development project. It can have a positive or negative effect on time and cost.

Hypothesis 2

H₁: Feedback and requirements are the critical factor that impact on agile software development in terms of project time

Hypothesis 3

H₁: Equal frequency of sprint/iterations deliveries impact agile software development in terms of project completion on time.

Hypothesis 4

H₁: Execution of agile development methodology by management has major impact on project cost and time.

V. RESEARCH APPROACH

Basic classification of Research approach has been categorized into two groups: Quantitative and Qualitative. The research approach used in this study is quantitative. This method is used to establish and employ statistical models, hypotheses and theory relating to phenomena. This method basically analyzes cause and effect, test hypotheses and make inference. The data comprises of numerals and statistics which is collected using validated and structured data-collection tool/instruments. These results of quantitative research can be generalized in a way that they are made, applicable to other scenarios and context through statistical and mathematical modeling. Data was collected from respondents through a structured questionnaire.

- **RESEARCH TYPE**

Research type depends upon the goals of the study. The study of research used for this study is Descriptive research as describe the significance of a situation, state, or existence of a specific phenomenon. Relational Research Problem -- suggests a relationship of some sort between two or more variables to be investigated. Moreover, this is also co-relational type of research as the researcher only measures the variables and their relationship.

- **RESEARCH TOOL**

Questionnaire has been used as a research tool/instrument to conduct this research. The questionnaire has been developed after extensive literature review of research work related to impact of time and cost for software development using agile techniques and informal interviews / interactions with relevant personnel. The researcher has developed the questionnaire himself and the questionnaire has been tested for validity and reliability tests.

- **STEPS IN QUESTIONNAIRE DESIGN:**

The Questionnaire has been developed following the steps described in Section number 2 and finally passed through

stages of validity and reliability by pilot project study based on 25 Nos. of sample questionnaires.

- VALIDITY OF QUESTIONNAIRE DEVELOPED

The validity and relevance of questionnaire developed has been verified by experts with vast experience from IT sector including regulatory bodies.

- RELIABILITY

The reliability of the research questionnaire has been verified through pilot study based on the sample size of 25 Nos. respondents from sample population. The Cronbach’s alpha test has been performed on each variable.

VI. ANALYSIS AND DISCUSSION

- INTRODUCTION

To achieve the research aims data is gathered directly from primary source so it does not contain much missing values or outliers as data is gathered from respondents directly and all information regarding to questionnaire are given to them. The analysis has been performed using statistical package of social sciences (SPSS). The data is measured on five point Likert scale while relationship among them is studied using correlation and linearity is discussed by regression analysis.

- DESIGN SELECTED

In this study, design selected is questionnaire-based survey research. The data set is gathered on five point Likert scale from strongly disagree to strongly agree. Data reliability and validity is checked using Cronbach alpha.

- POPULATION

To examine the results, the population of Islamabad and Rawalpindi is considered as target population so sample is fetched from that particular regions of Pakistan. The population of this study includes team leads, project managers, technical officers and scrum masters of Information Technology organization.

- SAMPLING DESIGN AND SIZE

It is difficult to analyze complete population and fetch information from each and every unit of population so a representative sample would be required. Thus, a representative sample of 81 respondents is obtained using simple random sampling technique.

DATA COLLECTION METHOD

The list of respondents compiled from professional circles and LinkedIn members with relevant roles. The questionnaire was circulated through web links by researcher.

- NORMALITY TESTING

Usually Normality tests are carried out in order to analyze whether the data is normally distributed or otherwise. There are two normality tests which have been used for this research. These are skewness and kurtosis.

a. Skewness

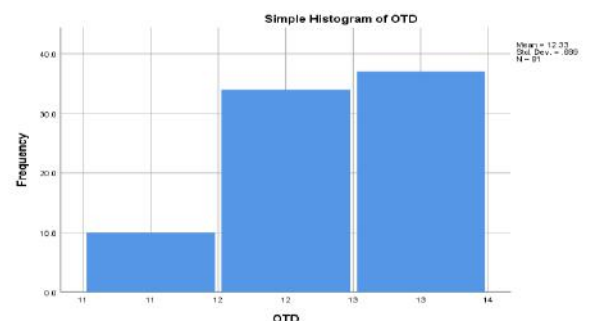
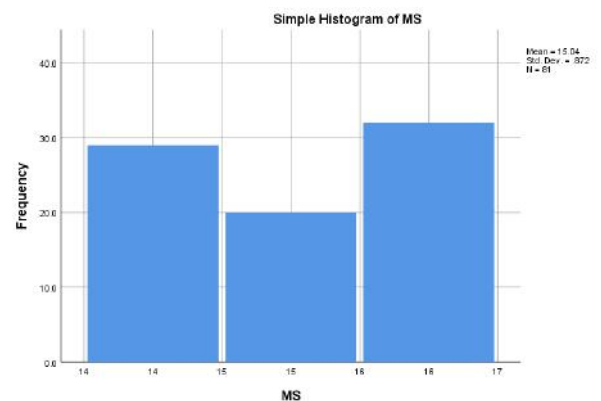
Skewness defines whether the data is skewed towards right or left. Skewness range is usually considered between -1 and +1. It can be seen from table 4-2 that all the variables used in the research have value of skewness falling within the range which shows that the distribution of our data is approximately symmetric.

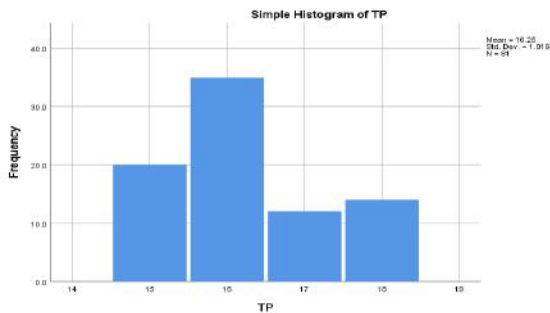
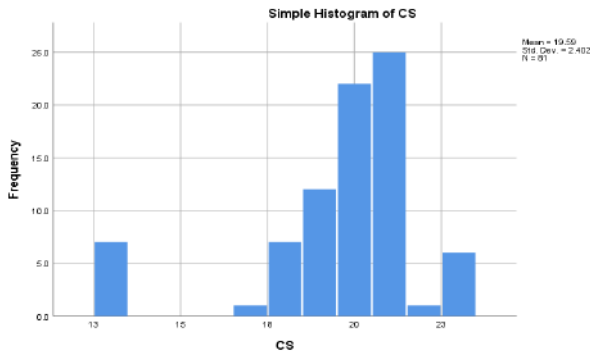
b. Kurtosis

Kurtosis explains the relative sharpness and the height of the distribution as compared to a normal distribution curve. It is usually considered that the range of kurtosis should remain between -3 and +3. It is quite clear from table 4-2 that the value of kurtosis for all the variables used in this research falls within the range which shows that the data is normally distributed.

c. Histograms

The Histograms of these variables are attached as shown below.





CRONBACH'S ALPHA VALUE

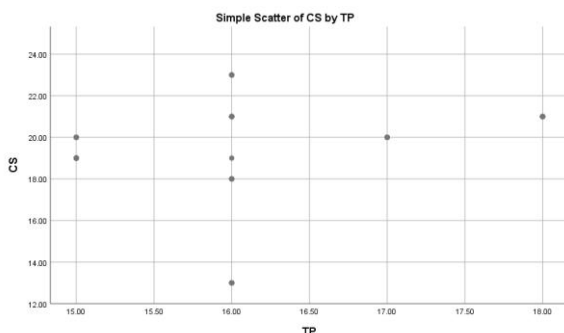
Table 4.1: Cronbach's Alpha Value

Sr. No	Variables	Cronbach value
1	Team Productivity (TP)	0.835
2	Customer Support (CP)	0.779
3	On Time Delivery (OTD)	0.783
4	Management Style (MS)	0.794
5	Project cost and time (PCnT)	0.824

The data is examined for reliability using Cronbach alpha for all the variables separately and for all of them combined as well. Thus, data appeared reliable.

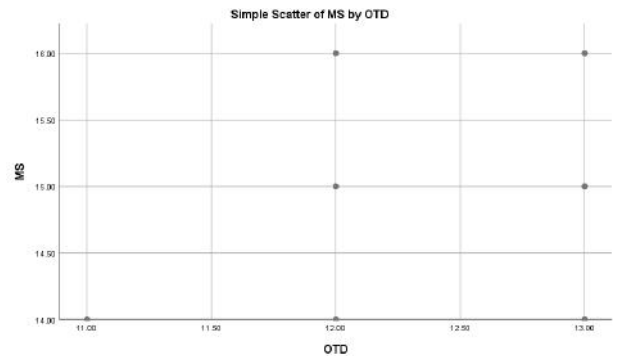
SCATTER PLOTS

Now, we would apply exploratory data analysis techniques and examine the relationship among variables. So, the simplest technique for examining relationship is scatter plot.



The scatter plot indicates not specifically linear relationship among TP and CS although we would examine

further linear relationship exists among other variables as well or not.



The scatter plot among OTD and MS also indicated no specific linear relationship among them. Although there appeared only block of four values which presents only that specific values.

CORRELATION ANALYSIS

The scatter plot indicated not specifically linear relationship among two pairs of variables now we would discuss relationship among all four pairs and examine the relationship is significant or not. The significance of relationship is discussed using p values for each pair of pearson relationship.

Table 4.2: Correlations Matrix (Pearson)

		Correlations				
		TP	CS	OTD	MS	PCnT
TP	Pearson Correlation	1	.233*	.593**	-.460**	.233*
	Sig. (2-tailed)		.037	.000	.000	.037
	N	81	81	81	81	81
CS	Pearson Correlation	.233*	1	.760**	.459**	1.000**
	Sig. (2-tailed)	.037		.000	.000	.000
	N	81	81	81	81	81
OTD	Pearson Correlation	.593**	.760**	1	.166	.760**
	Sig. (2-tailed)	.000	.000		.138	.000
	N	81	81	81	81	81
MS	Pearson Correlation	-.460**	.459**	.166	1	.459**
	Sig. (2-tailed)	.000	.000	.138		.000
	N	81	81	81	81	81
PCnT	Pearson Correlation	.233*	1.000**	.760**	.459**	1
	Sig. (2-tailed)	.037	.000	.000	.000	
	N	81	81	81	81	81

- *. Correlation is significant at the 0.05 level (2-tailed).
- ** . Correlation is significant at the 0.01 level (2-tailed).

The relationship among all variables is almost positive except Team Productivity and Management style as their relationship is negative. Although we observe p-values for all relationships is small so it seems significant relationship

among all pairs of variables that is also observed from asteric * signs above all values in SPSS output. Further, we observe the relationships are almost moderate as they are nearly equal to 0.5 and the value of relationship considered nearly equal to .5 is moderate relationship. While relationship among customer satisfaction and on time delivery is 0.76 which is largest among all relationships and its strongest. Further, all variables have significant relationship with dependent variable as well.

REGRESSION ANALYSIS

As, we observe significant relationship among all pairs of variables using correlation analysis so further linear relationship is discussed using regression analysis and explored how much increase in one variable causes increase or decrease in predictor variable. Here, project cost and time is considered as dependent variable and remaining variables act as independent variables.

Table 4.3: Model Summary

Model	R	R Square	Adjusted R Square	Std Error of Estimate
1	0.233	0.054	0.042	2.623
2	0.853	0.728	0.721	1.335
3	0.854	0.730	0.719	1.340
4	0.855	0.731	0.717	1.345

- a. Predictors: (Constant), TP
- b. Predictors: (Constant), TP, CS
- c. Predictors: (Constant), TP, CS, OTD
- d. Predictors: (Constant), TP, CS, OTD, MS
- e. Dependent: PCnT

Among these regression equations the second model has highest R square. So, we would say that maximum variation is explained by this model so, team productivity and customer satisfaction are explaining maximum variations as compared to all independent variables.

- a. Predictors: (Constant), TP
- b. Predictors: (Constant), TP, CS
- c. Predictors: (Constant), TP, CS, OTD
- d. Predictors: (Constant), TP, CS, OTD, MS
- e. Dependent: PCnT

The ANOVA table for all models are indicating significance due to smallest p values which seems goodness of fit for all models.

Table 4.4: ANOVA

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	31.117	1	31.117	4.523	0.037**
	Residuals	543.500	79	6.880		
	Total	574.617	80			
2	Regression	372.896	2	186.448	104.547	0.000***
	Residual	139.104	78	1.783		
	Total	512.000	80			
3	Regression	373.741	3	124.528	69.638	0.000***
	Residual	138.259	77	1.796		
	Total	512.000	80			
4	Regression	374.489	4	93.622	51.743	0.000***
	Residual	137.511	76	1.809		
	Total	512.000	80			

Regression Analysis	Unstandardized coefficients		Standardized coefficients	t	Sig.
Model	b	Std. Error	Beta		
1 constant	9.414	4.685		2.009	0.048**

Table 4.5: Model Summary

Regression Analysis	Unstandardized coefficients		Standardized coefficients	t	Sig.	
Model	b	Std. Error	Beta			
1 constant	9.414	4.685		2.009	0.048**	
	TP	0.612	0.288	0.233	2.127	0.037**
2 constant	3.789	2.445		1.549	0.125	
	TP	0.012	0.151	0.005	0.079	0.937
	CS	0.805	0.057	0.852	14.045	0.000***
3 constant	5.077	3.090		1.643	0.104	
	TP	0.103	0.201	0.041	0.511	0.611
	CS	0.856	0.095	0.907	9.043	0.000***
	OTD	-0.305	0.445	-0.083	-0.686	0.495
4 Constant	8.137	5.682		1.432	0.158	
	TP	-0.002	0.259	-0.001	-0.007	0.994
	CS	0.879	0.101	0.931	8.663	0.000***
	OTD	-0.245	0.456	-0.067	-0.538	0.592
	MS	-0.169	0.263	-0.058	-0.643	0.522

a. Dependent: PCnT

As shown in Table 4-5 model summary, the highest R square appeared for second model while ANOVA also indicated its significance of model so it is considered to be the best model while detailed analysis indicated customer satisfaction and team productivity have positive significant impact on project cost and time variable. Further the model equation would be written as;

Regression Equation

$$PCnT = 3.789 + 0.012 TP + 0.805 CS$$

- HYPOTHESIS TESTING

The research requires to analyze which of independent variable is significantly impacting on project time and cost. So, t test is examined for all the coefficients and p values determines their probability of rejection.

Table 4:6: t-values and the equivalent p-values

Hypothesis	Independent Variables	Dependent Variable	t-value	Significance (p-value)	Not Rejected/Rejected
H1	Team Productivity (TP)	Project cost and Time (PCnT)	-5.491	.037**	Not Rejected
H2	Customer satisfaction (CS)		6.471	.000**	Not Rejected
H3	On time delivery (OTD)		-5.648	.000**	Not Rejected
H4	Management Style (MS)		-2.538	.001**	Not Rejected

The table indicated that all variables have significant impact on project time and cost separately due to largest t statistics and smallest p-values.

VII. DISCUSSION OF RESULTS

The analysis indicated that independent variables team productivity (TP), management style (MS), customer satisfaction (CS) and on time delivery (OTD) all are impacting significantly on project cost and time (PCnT). Further, significant relationship exists among all of them due to high correlation. Also, regression analysis is performed to examine the linearity of model and the model including team productivity (TP) and customer satisfaction (CS) are expressing more variations as compared to others. Thus, they have more impact among all independent variables.

VIII. FINDINGS, CONCLUSIONS, RECOMMENDATIONS

- Introduction

The preceding section deals with introducing evidence and interpreting results in order to address the study's research questions. The emphasis of this section is the review of research-based results, study-derived recommendations, and conclusion. The section further presents the study's weaknesses and strengths. The aim of the analysis was to examine the impact of cost and time on software development using agile methods.

- Findings and Conclusion

It is important to mention here that success is measure by the customer's satisfaction, on time delivery, team productivity and management style with the final product and that is possible only in adopting agile software development techniques and these techniques can lead to project cost and time saving, the agile software development creates agility in our software business sector. The study provides insight on how to adopt and retain agile software development in the existing software industry within Pakistan. It also provides ways in which the companies can adopt and sustain healthy use of agile software development.

The main objective of the research was to analyses the impact of agile methodology on project cost and time. In addition to it, the results in section 4 of the case study provide with some useful information. Keeping in view the selected independent variables positively influence as found to have major impact of team productivity (TP), customer satisfaction (CS), on time delivery (OTD) and Management style (MS) on Project cost and time that are major findings by using Agile software development methodologies in software industry. The independent variables designed by summing the information of sample questions are team productivity, customer satisfaction, on time delivery and management style. The average showed maximum worth for customer satisfaction therefore it would say that there are largest percentage of contributors who are satisfied with techniques. The scatter plot indicates not specifically linear relationship among TP and CS and also indicated no specific linear relationship among OTD and MS. The relationship among all variables is almost positive except Team Productivity and Management style as their relationship is negative. Significant relationship among all pairs of variables using correlation analysis. regression analysis is performed to examine the linearity of model and the model including team productivity and customer satisfaction are expressing more variations as compared to others and analysis indicated customer

satisfaction and team productivity have positive significant impact on project cost and time variable.

Moreover, the findings of the study can be used to strength and extend the existing models of Agile Software development impact of project cost and time putting into practice in software industry. Academically, the study provides opportunity and avenue for research students who want to conduct research in this field. In this way, the study creates awareness among young researchers about the Agile Software development impact on project cost and time. Agile software development is providing more opportunities for the software industry as it is focusing more on the customer satisfaction / feedback and on time delivery. by focusing features on the needs it will save the project time and cost. Agile software developing is prevailing techniques for the software development, not only providing benefits the team productivity, customer satisfaction/ Feedback, on time delivery and management style but also maximizes the profit of the company by providing good quality of work, delivering the projects on the time and fulfil the customer satisfaction. They can develop new Agile Software development techniques and models for all types of projects.

Limitation and Contribution

As there is no agreed-upon way to measure the cost and time of agile software development. As a result, it is difficult to compare the cost and time of different agile software development approaches. The research is limited by its means of data collection. The data for the study has been gathered only one time so, it has a limited insight. If data might be collected more than one time it can yield much accurate results. Major portion of the data has been gathered from cities of Rawalpindi and Islamabad. The study is limited in ways that only covers the two cities of Pakistan not the overall markets of the country.

In the study, the respondents are all from Pakistan. If a comparative study were to be done, it should be carried out in other countries.

- Future Work

The past research statistics and experimental studies are analyzed to fetch out the most relevant conclusions to this study. A systematic experimentation and investigation work was carried out to prove the results of the previous studies and to form the factual evidence of this research. Some major past experimentation has been consulted to define the over-all idea of the underlying study.

In this study we have chosen 4 independent variables team productivity (TP), customer satisfaction (CS), on time delivery (OTD) and Management style (MS). This research work can be extended by adding mediator variables. Like

by adding uncertainty as mediator variable in team productivity can help out to extract more significant results.

REFERENCES

- [1] Ahmed, A., Ahmad, S., Ehsan, N., Mirza, E., & Sarwar, S. Z. (2010, June). Agile software development: Impact on productivity and quality. In 2010 IEEE International Conference on Management of Innovation & Technology (pp. 287-291). IEEE.
- [2] Cohn, M., & Ford, D. (2003). Introducing an agile process to an organization [software development]. *Computer*, 36(6), 74-78.
- [3] Coram, M., & Bohner, S. (2005, April). The impact of agile methods on software project management. In 12th IEEE International Conference and Workshops on the Engineering of Computer-Based Systems (ECBS'05) (pp. 363-370). IEEE.
- [4] Fergis, K. (2012). The Impact of an Agile Methodology on Software Development Costs.
- [5] Jain, P., Sharma, A., & Ahuja, L. (2018, August). The impact of agile software development process on the quality of software product. In 2018 7th International Conference on Reliability, Infocom Technologies and Optimization (Trends and Future Directions)(ICRITO) (pp. 812-815). IEEE.
- [6] Kula, E., Greuter, E., Van Deursen, A., & Georgios, G. (2021). Factors Affecting On-Time Delivery in Large-Scale Agile Software Development. *IEEE Transactions on Software Engineering*.
- [7] Livermore, J. A. (2007, March). Factors that impact implementing an agile software development methodology. In *Proceedings 2007 IEEE SoutheastCon* (pp. 82-86). IEEE.
- [8] Melo, C. D. O., Cruzes, D. S., Kon, F., & Conradi, R. (2013). Interpretative case studies on agile team productivity and management. *Information and Software Technology*, 55(2), 412-427.
- [9] Nasehi, A. (2013). A quantitative study on critical success factors in agile software development projects; case study IT company.
- [10] Tam, C., da Costa Moura, E. J., Oliveira, T., & Varajão, J. (2020). The factors influencing the success of on-going agile software development projects. *International Journal of Project Management*, 38(3), 165-176.
- [11] Ramírez-Mora, S. L., & Oktaba, H. (2017, October). Productivity in agile software development: a systematic mapping study. In 2017 5th international conference in software engineering research and innovation (CONISOFT) (pp. 44-53). IEEE.
- [12] Wafa, Rubab, Muhammad Qasim Khan, Fazal Malik, Akmalbek Bobomirzaevich Abdusalomov, Young Im Cho, and Roman Odarchenko. (2022). "The Impact of Agile Methodology on Project Success, with a Moderating Role of Person's Job Fit in the IT Industry of Pakistan" *Applied Sciences* 12, no. 21: 10698. <https://doi.org/10.3390/app122110698>

- [13] Ghimire, Dipendra, and Stuart Charters. (2022). "The Impact of Agile Development Practices on Project Outcomes" *Software* 1, no. 3: 265-275. <https://doi.org/10.3390/software1030012>
- [14] Shariq Aziz Butt, Tuncay Ercan, Muhammad Binsawad, Paola-Patricia Ariza-Colpas, Jorge Diaz-Martinez, Gabriel Piñeres-Espitia, Emiro De-La-Hoz-Franco, Marlon Alberto Pineres Melo, Roberto Morales Ortega, Juan-David De-La-Hoz-Hernández. (2023). Prediction based cost estimation technique in agile development, *Advances in Engineering Software*, Volume 175, 103329, ISSN 0965-9978, <https://doi.org/10.1016/j.advengsoft.2022.103329>.
- [15] Rahul, N. , Nouidui, T. , Ulaya, P. and Kiwia, D. (2023) The Impact of Agile Methods on the Software Projects Implementation and Management. *American Journal of Industrial and Business Management*, 13, 183-194. doi: 10.4236/ajibm.2023.134013.
- [16] Mishra, A., Alzoubi, Y.I. (2023). Structured software development versus agile software development: a comparative analysis. *Int J Syst Assur Eng Manag* 14, 1504–1522. <https://doi.org/10.1007/s13198-023-01958-5>