The Combined Effect of Project Complexity and Team Communication on Project Performance; Mediated by Team Collaboration

by

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Dedicated to my mama and siblings for their never ending love and support.

CERTIFICATE OF APPROVAL

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List of Publications

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Acknowledgements

Abstract

The recent studies in management literature have scarce knowledge on complexity of the projects and its relative impact over performance. The present study implores the situations that contribute towards the project performance within the contextual settings of Pakistan. The effect of project complexity on project performance has been studied for the present study. Data were collected by 289 respondents that were employed in different project based organizations. The results empirically substantiated that complexity of the project has a significant and negative impact on project performance. The mediating role of team collaboration is been tested and proved to be a potential mediator between complexity and performance and have a positive and significant mediation relationship between the two. Team communication acts as a moderator between project complexity and team collaboration but despite of strengthening, it is weakening impact of project complexity on team collaboration. The study contributes towards the literature, specifically towards project management literature. The study also significantly towards the project based firms primarily within the context of Pakistan.

Keywords: Project Complexity; Team Collaboration; Team Communication; Project Performance.

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Abbreviations

PC   Project Complexity

TC   Team Collaboration

TEC   Team Communication

PP   Project Performance

Chapter 1

Introduction

1.1   Background of the Study

Recent market trends have compelled the entrepreneurs to divert their attitude towards projectized firms. Project management approaches contributes positively towards the three basic constraints of the project (time, cost and scope) to improve the projects' performance (Berssaneti and Carvalho, 2015) and sustainability in project management practices tends to increase the success rate of the projects (Martens and Carvalho, 2016). Due to the exclusivity of projects, they tend to be of complex nature, and this nature inherently possess level of uncertainties and complexities contributing towards the unpredictable performance of the project even after the planned ways to achieve the desired outputs (Yan and Wagner, 2017; Bjorvatn and Wald, 2018). Complexity of the project can also be measured by the level of complexity of the product development such as size, hi-tech innovation, skills needed, etc. for which the project is initiated; as the latter's complexity contributes towards the project complexity (Hobday, 2000).

Complexity is considered as one of the obvious characteristics of the project due to its unique and innovative nature (Yang et al., 2014; Laine et al., 2016). Complexity of the projects obstructs the project performance (Hanisch and Wald, 2014; Tatikonda and Rosenthal, 2000) including triple constraints along with monitoring and control system (San Cristóbal, 2017), leading the project towards delays.

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Complexity is the evident feature of the temporary organization aka projectized firms and is defined as the number of dissimilar assignments having interdependency between them (Burke and Morley, 2016). (Baccarini, 1996) defines project complexity as having inter-related tasks and the nature of co-dependency between them; along with two major types of complexity i.e. organizational and technological.

(Xia and Lee, 2004) defined the complexity of information system projects in two broader categories as organizational/technological and structural/dynamic, requiring a need to develop a proper framework for complexity; thereafter (Bosch-Rekveldt et al., 2011) posit an appropriate TOE (technical, organizational and environmental) framework to recognize the concept of complexity on the basis of a specified theoretical structure. Furthermore, organizational complexity refers to the hierarchal structure of the firm and technological complexity refers to the transformation process needed to get the desired output (Baccarini, 1996; Williams, 1999). (Williams, 1999) further characterized the broader terms, but present study have focused the general project complexity concept as a single taxonomy. Project complexity is one of the growing and inevitable realities of projects and call for proper tools and techniques to cope with the ever changing market trends and faced ambiguities thorough out the project life cycle and take the needed and rightful decisions (Vidal et al., 2011), as a result contributing towards projects success. Complexity is a decisive measure of the projects success rate and needs to be managed as per the criticality level of the venture, and may lead to diminish the project performance or even lead towards failure of the latter (Benbya and McKelvey, 2006). Many of the characteristics can be used to categorize the projects out of which complexity is one of the obvious measure to categorize the venture (Bosch-Rekveldt et al., 2011).

Due to the complex nature of projects, it is difficult for an individual to cope up with the latter, therefore entails joint efforts by the team members. This requires better team collaboration in order to get the team familiar and comfortable working within a team, as the collaborated team performs well under complex situations (Espinosa et al., 2007), consequently leading towards better

project performance. Collaboration is said to be the potential tool in order to cope up with the uncertain and ambiguous situations and reduce them to lift up the project performance (Nidumolu, 1995; Croom, 2001; Melander and Lakemond, 2015). Collaboration assist the projectized organizations with the opportunity to exploit the experiences and technologies of the other firms and gaining advantage from their expertise and experience (Yan and Wagner, 2017; Peng et al., 2014; Yan and Dooley, 2014), thereafter, leading towards better project performance. Joint-Ventures is always one of the form of collaboration and many public-private partnerships exists to carry out the project, which also brings complexity along with it; requiring the partnership members to cope up with the allied risks and ambiguities (Van Marrewijk et al., 2008).

Projectized organizations are the idealistic form of firms in order to administer the complex nature of projects and tasks (Hobday, 2000) with ambiguity in goals and scope (Turner and Cochrane, 1993), therefore, complexity is the innate feature of project (Yang et al., 2014; Laine et al., 2016) and diminishes the performance of the project (Tatikonda and Rosenthal, 2000; Bakhshi et al., 2016), thereafter necessitate collaborative efforts and coordination by the team members in order to cope up with the complex situations (Grobman, 2005). Complex and innovative nature of the projects want the project team members to adopt a flexible and collaborative tool (Geraldi, 2009) in order to face the situations accordingly.

Planning is one of the bases of project managers in order to lessen the probability of risks and complex situations, but planning itself is said to be one of the complex tasks that needs to observed by the managers; thereafter complexity remains the integral feature of the projects and needs to be managed accordingly (Gidado, 1996). Different actions have different reliance on each other (Burke and Morley, 2016) and researches proved that team coordination assist the members to reduce the negative impact of interdependencies on the project performance (Wang et al., 2018).

In conjunction with many factors such as: project type and leadership style (Yang et al., 2011; ul Musawir et al., 2017; Müller and Turner, 2007; Zhang et al., 2018), formal controls (Kanwal et al., 2017; Liu and Wang, 2014; Tyssen et al., 2014),

acquisition of resources (Richey Jr et al., 2014) etc., communication system has the monotonous impact on team performance and collaboration resulting in better project performance (Chan et al., 2004). Team Communication plays an important role to communicate the information needed by the team members (O'Daniel and Rosenstein, 2008; Holton, 2001), as the former plays an important role to understand the clear goals of the concerned members and help them to collaborate in a best possible way (Suter et al., 2009) and team organization facilitates the process of communication and collaboration in order to contribute towards the project success (Chiu, 2002).

Communication plays a vivacious role between the team and is also one of the fundamental bases for team collaboration (Siakas and Siakas, 2008; Reina et al., 2007). Collaboration breeds innovation and inventiveness among team members (Barczak et al., 2010; Simatupang and Sridharan, 2002; Um and Kim, 2018), and each of the latter's construct needss effective communication skills (Siakas and Siakas, 2008; Reina et al., 2007) in order to collaborate effectively and contribute towards better project performance. Knowledge sharing attitude of employees is the evident outcome complexity and leads towards team creativity (Hussain et al., 2017) and involves clear and effective communication channels to avoid indistinctness and complexity (Park and Lee, 2014), thereafter, contributing towards the enhanced performance of the project.

1.2 Gap Analysis

There is scarcity of pragmatic evidence on the complexity feature of the project and its impact on performance. However, since the past decade, uncertainty of the projects with its impact on the latters' performance have been extensively studied (Bosch-Rekveldt et al., 2011; Chan et al., 2004; Thomas and Mengel, 2008), yet specifically ignoring to implore the impact of Project Complexity on project performance. Since the complexity is the underpinning feature of the project (Burke and Morley, 2016), yet, the knowledge of the latter on project performance is scarce. Team collaboration is referred to as 'Horizontal Collaboration" where two

or more members of the same team combine to complete the task (Simatupang and Sridharan, 2002) and is used as mediators in the previous studies (Um and Kim, 2018), yet ignoring the collaboration to be measured as a mediator specifically between project complexity and performance.

Communication is a decisive job in dealing with groups and conflict resolution among the team members (Henttonen and Blomqvist, 2005); also, the communication effectiveness is not tried as a moderator between complexity and collaboration. Communication plays an important role in managing teams and reducing distance amongst the members (Henttonen and Blomqvist, 2005), thus far, the communication effectiveness is not tested as a moderator between complexity and collaboration phenomenon.

Collaboration as a mediator is been tested by (Um and Kim, 2018) between the product development and success in the manufacturing industry only, thereafter the present study fill the specified gap of testing the former as a potential mediator between project complexity and performance in the projectized firms with the moderation mechanism of effective team communication, which plays a focal role in better collaboration of the team members and diverting the complex project towards success.

It is not tested in Pakistani context along with its applicability in projectized firms so far, therefore the present study fills the specified gap. Collaboration as a mediating factor between product uncertainty and performance is been empirically implored but in Korean manufacturing firms only (Um and Kim, 2018) along with no moderation mechanism, thereafter, the contextual factors of Pakistan is one of the obvious opportunities for research in order to contribute towards the management literature and project based organizations.

1.3   Problem Statement

Project complexity is one of the emerging and critical factors of the project due to its novel nature. Project complexity has many dimensions, but the present study capture the complexity as a broader aspect that encounters the specific project

proportions. Most of the delays are caused due to the complexity and innovativeness, therefore the dimension needs to be implored further. Many projects are undergoing in Pakistan specifically IT and construction projects and almost every project is delayed and causing a lot of cost overrun and complexity of project and environment is one of the causes of delays, thereafter the dimensions needs to be implored with reference to Pakistan.

Complexity of the task motivates the team members to collaborate for it and complete in due time. One person cannot have the complete knowledge of each and every dimension so collaboration needs to be adopted by the members in order to collect and donate knowledge of each other in order to complete the task effectively and timely. Along with the complexity, human factor is also one of the reasons of projects success and team members' synchronization is also one of the tools to manage complexity and elevate the performance of the project.

Communication is one of the necessary requirements for the people to mingle up and collaborate to achieve the anticipated project goals. Communication is said to be one of the important requirement to share the relevant information among the project team and their efficient collaboration in order to contribute towards the raised project performance with respect to the basic constraints of the respective project. To collaborate, communication is mandatory among team members therefore the moderator needs to be tested on team collaboration. Moreover, the research will provide argument for the projectized organizations in order to assist them to deal with the uncertainty of the undertaken projects.

1.4   Research Questions

On the basis of above mentioned problem, the current study aims to uncover the following aroused questions:

Research Question 1

Does the relationship exists between Project Complexity and Project Performance?

Research Question 2

Does Team Collaboration mediates the relationship between Project Complexity and Project Performance?

Research Question 3

Can effective team communication moderate the relationship between complexity and collaboration?

Research Question 4

Is the study significant within the contextual factors of Pakistan?

1.5   Research Objectives

The overall objective of the study is to test the proposed theoretical framework in order to find out the relationship between project complexity, team collaboration and project performance. Moreover, effective team communication is added as the possible moderator for the predicted relationship so as to implore its relevant impact on collaborative performance.

The explicit objectives of the study are stated below:

Research objective 1

To investigate the relationship between project complexity and project performance.

Research objective 2

To explore the association between project complexity and team collaboration.

Research objective 3

To implore the impact of team collaboration and project performance.

Research objective 4

To investigate the liaison between team communication and team collaboration.

1.6   Significance of the Study

Projectized organization's scope is up-and-coming since the past decades and are considers as more convenient form of organizations in order to provide the relevant services. There are many projects that are currently undergoing in our country and every project has different environment, features, scale, needed skills, timeline, etc., and each of the projects has different reactivity towards its environment too. Therefore, projects tend to be of unique and novel nature, which elevate the complexity of the latter.

Due to the complex and exclusive nature of the projects more of the time is allocated to its planning, yet, contingencies are also planned along with its reserves so as to cope up with any of the uncertain situation faced during its execution and direct reactivity with the real factors under which project is taking place; hence complexity of the project needs to be taken seriously in order to eradicate the negative impacts and consequences that can be borne if ignored. The current study aspires to investigate that how the intrinsic complexity feature affects the project performance and how can it be accommodated using the effective communication and collaborative performance of the team members.

Due to above mentioned literature, it is ascertained that; as of ever changing and swiftly varying market trends, uncertainties have become more obvious and intrinsic feature of the projects. The blooming augment and growth in technological advancement have become one of the foundations for complexity to be the characteristic and the factor inhibiting the project performance. It is also evident that project teams are of diverse nature and every member has its own special and separate set of skills required to complete the project goals. Therefore it is obvious that there is no single person that can acquire every needed mastered skill needed by the project completion and performance. Thereafter, requiring the collaborative performance of the team affiliates to reduce the complexity and boost performance.

Project management and its literature is one of the emerging areas of study. The need for project managers is booming as many of the organizations have started

working as projectized firms. Moreover, due to the competitive market trends and innovative environment the complex behavior of projects is evident and is also pointed out by project management institute that the managers must be trained in a way that they are able to adapt to the complex and ambiguous situations faced during the project duration.

Therefore, the study theoretically contributes towards the literature of project management in the interest of knowing the relationship between project complexity and project performance and coping with uncertainty through collaboration and communication. Scarcity of existing literature on complexity and the anticipated model have a say in imploring the proposed relationship and assisting the project managers to know the ways in order to cope up with complexity.

The study have practically contributed towards projectized firms of Pakistan and exploring that how the unique, novel and complex nature of the projects creates hindrances for the better project performance. This study investigated that how the firms use the collaboration as a tool to get by the complex situations faced during the project and will provide evidence for communication among the team members as a catalyst for their collaboration, as a result achieving the better performance of the project concerting the triple constraints of the respective venture.

1.7 Supporting Theory

The underpinning theory of the projected speculative framework is complexity theory which was proposed by (Kauffman, 1993) in social sciences and is explained further with its relativity with project management.

1.7.1 Complexity Theory

The concept of self-organization rather than evolution is given by (Kauffman, 1993) which was further carried out by (Mathews et al., 1999) so as to introduce the concept of complexity sciences in social sciences. Complexity theory advocates the concept of non-linearity and ambiguity. Kauffman also stated that complexity

theory provides the basis for the phenomenon that how independent team members unanimously represent the patterned behavior and collaborate with each other so as to deal with the ambiguous situations. Complexity Theory integrates concepts of various disciplines explaining complex phenomenon in the related domains. It observes that complex behavior comes from few simple rules, and that all complex systems are networks of interdependent parts which interact according to those rules (Grobman, 2005). Complexity theory advocates that the organizations are the self-adaptive systems inherited with complexity (Saynisch, 2010) and are impulsive as per their adaptation and organization is concerned with reference to the changing environment (Burnes, 2005).

The aforementioned theory demonstrated the concept as emergence, self-evolution and non-linearity which is the nascent phenomenon discussed in project management; as the latter has undergone a paradigm shift from predictability to adaptability (Cooke-Davies et al., 2007). (Rose and Kodukula, 2011) posit that complexity theory is a concept used to manage the project teams in order to breed creativity needed to complete the project goals. Complex environment and chaos acts as a catalyst to elevate the complexity of the projects when reacting with those situations and restrain the performance of the project; requiring the management literature to shift from certainty to compliance (Jaafari, 2003).

Therefore, the leaders must trust the subordinates and allow them to use any form of communication channel instead of being stick to the prescribed processes so as to adapt according to the evolutionary and complex situations (Grobman, 2005). (Saynisch, 2010) suggested that project management needs to shift from traditional approaches and allow the members to adapt according to the complexity of the situation through coordination and cooperation, thereafter, supporting the proposed model where inherent complexity of the project requires the collaborative efforts in order to provide the better project performance.

Chapter 2

Literature Review

2.1 Project Complexity

(Baccarini, 1996) states project complexity as one of the critical dimensions of the project and defines the former in terms of "differentiation- the number of varied elements, e.g. tasks, specialists, components; and interdependence or connectivity- the degree of interrelatedness between these elements". (Baccarini, 1996) also substantiated that complexity is subjective to the members' understanding and relative dealing with the complex task and situations like, scope definition, project objectives, etc. Project Complexity has two broad categories and they are structural uncertainty and uncertainty; where the first taxonomy is derived into two abstractions i.e. number of elements in the respective project and their interdependence and the second is defined as uncertainty in targets and tools and techniques to achieve those (Williams, 1999).

(Bosch-Rekveldt, 2011) posit a proper framework including three abstractions as technical, organizational and environmental i.e. TOE framework, and substantiated that projects can be complex in these three ways and every category needs to be cope up according to the level of complexity.

2.2   Team Collaboration

Collaboration is of two types i.e. process and relationship (Cao and Zhang, 2011) and the present study focuses on the abstractions of the former type and is defined as two or more persons/parties working together in order to achieve agreed outputs and targets (Sheu et al., 2006; Cao and Zhang, 2011; Um and Kim, 2018).

2.3   Team Communication

Team Communication "represents a symbolic behavior that occurs as a transaction among people, in which all the parties are continually and simultaneously sending and receiving information to develop a sense of shared meaning (Harris and Sherblom, 2018).

2.4   Project Performance

While talking about project performance, there is no single definition of project performance; rather having subjective measures with relevance to every stakeholder involved in the project (Dai and Wells, 2004; Bosch-Rekveldt et al., 2011; Pollanen et al., 2017). Researchers further corroborated that project performance can be measured next to time cost and scope also referred to as "the management triangle" alongside the quality of provision of services (Shrnhur et al., 1997; Atkinson, 1999; Boyne and Gould-Williams, 2003; Bosch-Rekveldt et al., 2011).

2.5   Project Complexity and Project Performance

Before eliciting the literature to support the relationship between project complexity and project performance, there arises a need to define that what basically the project is. The project is illustrated as:

"A project is an endeavour in which human, financial and material resources are organized in a novel way to undertake a unique scope of work, of given specification,

within constraints of cost and time, so as to achieve beneficial change defined by quantitative and qualitative objectives" (Turner, 1999)".

This novel and constrained nature of the project makes them complex and lessen the performance of the project (Yang et al., 2014; Laine et al., 2016; Tatikonda and Rosenthal, 2000).

Most of the projects are not successful with respect to the specifications needed because of the interdependency feature between them (Baccarini, 1996; Yan and Nair, 2016; Yan and Dooley, 2013, 2014). This interdependence can be administrative, task or physical location of members; all of them causing uncertainty in the relative project (Yan and Nair, 2016), and uncertainty is said to be one of the forms of complexity (Williams, 1999; Yan and Wagner, 2017) which therefore impedes the performance of the project (Tatikonda and Rosenthal, 2000; Um and Kim, 2018; Bjorvatn and Wald, 2018).

There is no communally agreed definition of project complexity but every research have proved a negative association between the complexity of the projects and their relative performance as per the agreed acceptable criteria (Bosch-Rekveldt et al., 2011; Yang et al., 2014; Bjorvatn and Wald, 2018; Um and Kim, 2018). (Cooper and Kleinschmidt, 1995) have categorized the project performance under two broad categories and they are "Financial performance" and "time performance"; referring to the performance related to profitability, cost, market share and in time delivery of the project respectively. Both of these performance measures are the part of "the management triangle" (Atkinson, 1999; Berssaneti and Carvalho, 2015) on which (Bjorvatn and Wald, 2018) explicitly established the negative influence of the project complexity. Performance of the project is also measured by the project's emerging properties' ability to manage and cope with the complexity level of the respective project (Zhu and Mostafavi, 2017) and there are many factors constituting towards complexity of the project e.g. size, interdependence, technical novelty, ambiguity, etc. and each of this factors has a negative impact on project performance (Williams, 1999; Sicotte and Bourgault, 2008; Um and Kim, 2018; Bosch-Rekveldt et al., 2011). There are many factors that contribute towards the complexity of the project and each of them are necessary to

drive the project for success and needs to be managed in a way that complexity can be minimized as possible (Nguyen et al., 2018); as scholars have validated that the complexity of projects grows at a faster pace than the ability to cope up with that complex situation (Maylor and Turner, 2017).

Projects are always initiated for a unique set of objectives to be achieved (Hobday, 2000), where complexity is inherent (Laine et al., 2016); as of product and process complexity both different with different level of criticality and intensity and causing higher level of complexity among the personnel executing the project due to the interpretation of the information subjective to each member (Vickery et al., 2016) and team members of the project plays an imperative role in better project performance (Um and Kim, 2018; Bjorvatn and Wald, 2018). Another form of complexity diminishing the project performance is task interdependence which can cause the project to delay or over budgeted because no task can be completed if every fragment of the task is not completed individually by the respective project member because independency and chronological nature of the tasks require every concerned member to complete the allocated work in time as single delay can cause the whole task to delay (Bailey et al., 2010), consequently delaying the project. Product and processes interaction and the complexity level of interaction between the two also enhance the project complexity and effect the product or project's performance in terms of delay commencement, excessiveness etc. (Bailey et al., 2010).

Uncertainty can also be caused by the difference in information needed to complete the task and acquired by the organization (Tushman and Nadler, 1978), consequently leading towards inhibited project performance. Furthermore, technological innovation is one of the forms of complexity in this era of technological advancement and is always perceived as complexity by the team members as adaptation and change is always resisted by the employees so as to avoid uncertainties allied with the advancement (Yan and Dooley, 2013). (Bjorvatn and Wald, 2018) illustrated that the project team members have certain set of skills and abilities that they are equipped with in order to achieve the targeted goals but those

abilities are negatively affected by the level of the complexity in the project; consequently effecting the project with respect to cost and time excessiveness. (Gidado, 1996) have developed an exclusive numerical model to measure the level and seriousness of complexity as a quantifiable approach in order to know its effect on time and cost of the project, thereafter explaining complexity as one of the important and inherent feature of the project and affecting the performance based on the intensity of complexity and its respective impact on performance.

Conclusively it can be portrayed that the projects are becoming more and more complex everyday due to its size, novelty, technology and many reasons, thus contributing towards late delivery and over budgeted projects and poor performance (Bosch-Rekveldt et al., 2011). Diverse edges between the teams and members also contribute towards complexity (Antoniadis et al., 2011). The complex nature of projects tends to diminish the ability of the leader to integrate its multiple parts for better performance (Green, 2004), where, extensive research has been done on leadership effectiveness and project performance (Lim and Mohamed, 1999; Dwivedula et al., 2016), consequently compelling us to hypothesize that:

H:1 *There is a negative relationship between project complexity and project performance.*

2.6 Project Complexity and Team Collaboration

A team is defined to be a group of people working together for a defined time span and coordinating with each other in order to achieve shared and agreed objective that cannot be achieved by a single person (Salas et al., 1992) and is suggested by the researches that the environment of the working team change in an uncertain pattern and requires the members to adapt according to the varying situations and its effectiveness is dependent on how well the team collaborate, adapt and react to the particular uncertain state of affairs (Gorman et al., 2018) along with the situation analysis and interpretation in order to cope up with the complex and uncertain situation (Prince et al., 1995). Collaboration is a two-faced phenomenon labeled as process and relationship collaboration (Cao and Zhang,

2011), where the present study focuses on process collaboration and is defined as all the activities related to the responsibilities that needs to be performed for efficient project completion like sharing of information, co-decision making and incentive alignment (Bowersox et al., 2003; Sheu et al., 2006; Simatupang and Sridharan, 2002, 2005).

Information sharing confides the concept of propagating the necessary and needed information between the team members and this information must be timely, relevant and accurate (Park and Lee, 2014; Simatupang and Sridharan, 2002, 2005). Information sharing is been declared by many scholars as the corner stone for efficient and effective collaboration among the members and enhance the project quality by knowing the relevant knowledge and skills acquired by every participant (Lamming, 1996; Min et al., 2005; Cao and Zhang, 2011; Simatupang and Sridharan, 2005) and enables them to cope up with the uncertain and ambiguous environment and situation (Gorman et al., 2018; Um and Kim, 2018).

Another source of collaboration is joint decision making that refers to the process of "decision synchronization" along with every member of the team and those decisions are of planning and operational nature; where the former decisions are related to long-term decisions as targets and goals to be achieved, and the latter is concerned with the decisions need to be taken on daily basis while executing the project (Simatupang and Sridharan, 2005; Cao and Zhang, 2011; Sheu et al., 2006). Complexity of the project also calls for the efficient and collaborative planning of financial and non-financial resources by the team members in order to contribute towards the project performance and let them able to deal the complex situation (Yan and Dooley, 2013).

The next source of team collaboration in the present study is incentive alignment. Incentive alignment is said to be the extent to which the team members of a particular team share their losses and profits as of risk, cost and benefit (Simatupang and Sridharan, 2005) and provide a strong support to their commitment towards the project and let them work in order to achieve the mutually agreed objectives and targets and acts as a medium for the members to stay on the direction to reach towards the jointly approved goals (Um and Kim, 2018).

Growing market trends and competitive environment in this technological era have increased the knowledge and preferences of the customers and arose a need to initiate the intended projects; with inherent complexity feature within the project due to the uncertain and continuously changeable environments (Simatupang and Sridharan, 2002). The new undertaken projects have an inherent characteristic of complexity, uncertainty, dependence of the tasks and technological fluctuation, thereafter, requiring the relevant team members to produce collaborative performance so as to deal the complexity and uncertainty accordingly (Peng et al., 2014). (Peng et al., 2014) demonstrated that the team collaboration can be enhanced by using information technology tools in order to elevate and enhance the effectiveness of the team members' collaboration. An advanced level of the project complexity direct towards the misleading analysis of information, especially at the start of new project where information is ambiguous and high-level only; and this misinterpretation may result into incorrect market analysis and poor project performance, yet requiring the project team to collaborate effectively in order to minimize the risk that can occur in long run (Um and Kim, 2018).

The projects are said to be initiated for a unique and temporary purpose, making innovation and complexity as inevitable social realities of the projects and the only way to minimize or lessen the complexity level is the cooperation, creativity and collaboration of the team members responsible for the execution of the relevant project (Cicmil and Marshall, 2005; Stokols et al., 2008). (Barczak et al., 2010) uphold that the creativity of team members is necessary to insight the opportunities and provide the best possible solution for the complex problems faced and their collaborative efforts breeds the creativity in best possible way and exploit the opportunities by minimizing their complexity, thereafter supports that complexity of the situation leads towards the members' collaboration in order to provide with the creative solutions. As projects are complex and innovative, creativity is required to respond to the ambiguous situations; and creativity is stimulated by the various ideas presented by the members and to present and discuss about the ideas collaboration is needed (Uzzi and Spiro, 2005), consequently providing a framework to the concept that complexity of the projects leads towards team

collaboration.

On the basis of abovementioned literature, it can be convincingly presented that collaboration is the key to success whenever new project is undertaken (Peng et al., 2014). (Espinosa et al., 2007) have also generalized that complex situations are always sorted out through better team collaboration. (Peng et al., 2014) and (Floricel et al., 2016) also evidenced from their respective studies that uncertain and complex situations faced during the project life cycle can be minimized through collaboration by exploiting the experience and knowledge of each other to find the market demand and trends in order to effectively deal with the uncertain and ambiguous situations, therefore, we hypothesize that:

H2: *There is a positive association between project complexity and team collaboration.*

2.7 Team Collaboration and Project Performance

Collaboration's concept is ingrained in symbiotic advantage where effective collaboration maximizes the firm's performance and minimizes the transaction costs (Dyer, 1997). For the projects to perform better and gain competitive advantage from other firms and projects they have to focus on collaborative advantage rather than competitive advantage with in the project team in order to reach towards the mutually beneficial and agreed objectives and contributive the positive effects to better project performance (Dyer and Singh, 1998). Collaboration comes to play when a single person is unable to complete the dedicated task and helps to exploit each other's resources and skills along with sharing and distributing the risk in order to lessen its impact (Huxham and Vangen, 2013). Therefore, a plethora of researches have provided a foundation for the relationship of collaboration and project performance (Um and Kim, 2018; Simatupang and Sridharan, 2005; Cao and Zhang, 2011; Sheu et al., 2006). (Duffy and Fearne, 2004) have established that inter-team relationships help the team members to effectively manage them and involve in planning and decision making effectively so as to elevate the project performance.

Information sharing is based on the association and readiness of the members forming the team so as to collaborate effectively to lift up performance of the project (Fawcett et al., 2007). Sharing of information and cooperation among the members of project team has a dyadic relationship with the performance of the project as successful project execution require interdisciplinary communication and cooperation in order to share all the needed information timely and to be compliant with the innovative nature of the projects so as to enhance the probability of project's success (Olson et al., 2001). In concurrence with leadership style (Keller, 2006), team composition, characteristics and cohesion among the team members are the major antecedents for the optimal financial and time performance of the project team (Ammeter and Dukerich, 2002) along with the information sharing mechanism that helps the team affiliates to share and make use of each other's skills and expertise by minimizing the task and relationship difference among themselves (Moye and Langfred, 2004) and enhance their performance and creativity to facilitate the improvement of the project performance (Zhao et al., 2002; Carr and Kaynak, 2007; Mesmer-Magnus and DeChurch, 2009).

Incentive alignment refers to bring into line the reimbursement and burden within the working team and encourage the members to align the personal objectives and goals with the overall goals and objectives of the project so as to gain the collaborative advantage (Simatupang and Sridharan, 2002) because higher the incentive alignment ratio, higher would be the positive and strong relationship between the participants in order to elevate the performance of project and respective project team (Westphal, 1999). Researchers have illustrated that misaligned incentives comes into play when the management fails to assist the members to align their goals with the overall targets and affecting the projects performance (Simatupang and Sridharan, 2002).

Along with task interdependence of the team members involved in completing the relevant tasks, "environmental dynamism" is a key factor influencing the performance of the team (Pearce, 1997) requiring the members to make the coordinated decisions rather than decentralized ones because every members' task is directly or indirectly dependent on each other and call for the members to take decisions

by involving each other so as to result in better performance of the team and consequently as of the project (Eliashberg and Steinberg, 1993). It is being said that strategic and joint decision making plays a vital role in enhancing the project performance and can result in conflicting situation when there comes a point of difference (Amason and Schweiger, 1994) but this situation can be avoided if incentive alignment between the members is high (Westphal, 1999), consequently both the abstractions of collaboration contributes towards better project performance.

On the basis of the above discussed literature it can be summarized that deliberate decision making is required to enhance the projects performance (Amason and Schweiger, 1994). Diverse ideas are required to solve the complex problems therefore joint decision making is preferred. Many of the business problems can be solved by sharing knowledge (McDermott and O'dell, 2001), and the latter contributes positively towards project success and better performance (Srivastava et al., 2006). As information sharing and decision making are the constructs of collaboration and the latter contributes positively towards the better performance of the project and meet the success criteria (Um and Kim, 2018; Yan and Wagner, 2017), we hypothesize that:

H3: *Team collaboration is positively related to project performance.*

2.8 Team Collaboration Mediates the Relationship Between Project Complexity and Project Performance

Projects are said to be of unique and temporary nature and are always initiated to achieve particular set of goals (Hobday, 2000), also having uncertainty and ambiguity in scope of work and objectives that needs to be achieved when reacting to the environment of project execution (Turner and Cochrane, 1993), hence complexity being the intrinsic feature of the project and lessen the project performance (Tatikonda and Rosenthal, 2000; Bakhshi et al., 2016; Yang et al., 2014; Laine et al., 2016). Team work is required to manage the complex and uncertain

nature of the projects and calls for the collaborative efforts of the team members so as to have better performance (Chiocchio et al., 2011; He et al., 2007). Objective identification is one of the important and critical tasks when working in teams and acts as a significant gauge to measure the project performance; where the quality of this team work is dependent on how effective the collaboration among the members was and therefore adds to the better performance of the project with reference to the triple constraints of that project (Högl and Parboteeah, 2003).

Knowledge management has given a great deal of importance in the field of project management now a days and been illustrated that the utilization of created and stored knowledge within the organization has a positive impact on the project performance (Dimitriades, 2005). In this context it is illustrated by the researches that the knowledge and skills of every individual is necessary for efficient performance of the project but can be enhanced by using the mechanism of "knowledge networking" as it is effective for the team performance because the members will be aware of each other skills and use whenever required and will not be in need to acquire every skill needed because knowledge networking will assist them to assign the tasks in a way that every member should get the task in compliance with his/her respective set of knowledge (Akgün et al., 2005). (Akgün et al., 2005) also illustrated that knowledge of each other's knowledge and skills acts as a transactive memory system and members can use it as an additional memory to their own limited set of skills; thereafter proving that the complexity of new projects requires to activate the process of knowledge networking among the team members in order to improve the project performance.

Complex nature of projects is an inevitable reality of the projectized organizations; but the pessimistic impact of the latter can be avoided or reduced when working in teams (Fisher et al., 2018). While working in teams (Yang et al., 2011) have established the positive correlation between team work and project performance. (Yang et al., 2011) have defined team work with respect to the communication among team members, team collaboration and cohesiveness; out of which team collaboration is one of the most decisive aspect that determines the better team performance and is the evident outcome of the complex nature of project tasks

(Gladstein, 1984). Furthermore, many researchers have established a positive association between effective collaboration and its impact on project performance relative to the intensity of the effectiveness of the collaborative efforts of the team (Um and Kim, 2018; Cao and Zhang, 2011; Simatupang and Sridharan, 2005; Dyer, 1997).

Group and team work during the project life cycle has become the need to achieve organizational goals and requires collaborative efforts of every member because if members are unable to develop common understanding among team then the process is time consuming and are not effective towards performance of the project (Levesque et al., 2001)İt is also exhibited that familiarity among the members and task help the participants of relevant team to have a well co-ordinated structure of team where coordination is also dependent on the nature and level of complexity of the project (Espinosa et al., 2007) consequently being the antecedents for project performance. As many researchers have proved that the complex nature of tasks hinders the project performance (Yan and Dooley, 2014; Hanisch and Wald, 2014; Tatikonda and Rosenthal, 2000; Peng et al., 2014) have proved the collaboration to be the foundation of new product development. Team Collaboration helps the members of the team so as to face the ambiguous and uncertain environment in such a way that it diminishes the pessimistic impact of project complexity on performance (Nidumolu, 1995; Melander and Lakemond, 2015), therefore we hypothesize that:

H4: *Team Collaboration mediates between project complexity and project performance.*

2.9 Team Communication Moderates the Relationship Between Project Complexity and Team Collaboration

Communication is defined as exchange of information, feelings and opinions both verbally and non-verbally and illustrated that the effective collaboration and performance of team is dependent on how effective were the communication channels between the team members (O'Daniel and Rosenstein, 2008). Team communication plays an important role in managing teams and reducing differences among members (Aga et al., 2016; Wang and Howell, 2010), therefore, for the communication to be effective, sender must communicate in a way that is easy for the receiver to interpret and act accordingly so as to improve the performance of the member (Harris and Sherblom, 2018), thereafter enhancing the overall team collaborative efforts. In today's era, the need for innovative and rapid development projects is increasing at a highest pace as of the growing competitive market with complexity being the innate feature and compelling the organization to shift from functional to projectized firms and require effective collaboration between the project team members in order to comply with the growing market trends (Pinto and Pinto, 1990). (Pinto and Pinto, 1990) have also laid down the fact that the well-coordinated and collaborative teams leads towards projects success and coordination and collaboration is being enhanced only in the teams who were having effective communication both formal and informal between them in order to exchange the needed and important information whenever needed and required following the best possible channel.

New product needs to be launched within the limited and short time period in order to gain competitive advantage and also meeting the growing technological trends require the traditional functional firms to shift to projectized firms so that specialized teams can work simultaneously on the product development requiring the team and sub-teams to coordinate in order to meet the specifications along with deadline criteria (Edmondson and Nembhard, 2009). This approach makes complexity as one of the evident features of the project (Berssaneti and Carvalho, 2015), also, requiring the firms to have teams with different geographical locations with diverse and specific skills needed to complete the project within the constraints defined but calls for the difficulty to collaborate effectively due to the communication barriers between those diverse teams and may result into reduced

team performance (Daim et al., 2012). Due to the emerging market trends and technological advancement the concept of virtual team has gain a lot of importance where the members of the teams are not co-located in order to acquire best possible skills for the project and product development. The virtual team members are distantly located to each other and can only communicate using the technological means i.e. computer-mediated communication (Berry, 2011). (Berry, 2011) have also illustrated that virtual teams are the best way in order to exploit the talent of individuals across the globe but they are of complex structure and face difficulty to collaborate because of time barriers between them; thus far requiring effective communication protocols along with channels so as to produce optimal team performance, consequently making communication as one of the necessary requirements for the team to become effective and achieve the set goals.

Apart from continuous resource commitment (Cuellar et al., 2007) and professional competence with understanding of the respective role to perform (Suter et al., 2009), communication among the project team is one of the causes that can lead towards the project failure as it is a very complex process comprising of many transmission channels (Allen, 1970). Knowledge sharing is an evident requirement in the project to avoid ambiguities and uncertainties thereafter requiring an efficient communication process so as to survive all such situations throughout the project life cycle in order to enhance the collaborative efforts through effective communication and in turn elevating the project performance (Park and Lee, 2014).

(Aladwani, 2002) have presented that the performance of the project is dependent on its contextual settings i.e. under with social situations the project is being executed because the social behavior of the participants is one of the predictors of the better project performance because (O'Daniel and Rosenstein, 2008) have indicated that the intrinsic complexity along with the limited capacity of the individuals calls for the cooperation and coordination among the participants, thereafter requiring the effective communication standards and procedures to communicate the complex information at the time of dissemination. Moreover, for the successful delivery of the projects, along with traditional procedures and policies,

human factor involvement is one of the critical aspects that involve effective team communication and coordination to respond a certain ambiguous and complex situation (Leonard et al., 2004).

Resources are to be provided by the organization so as to complete the project timely. Many researchers have proven that the latter is effective for the programs' timing and performance along with the quality of service (Richey Jr et al., 2014) but are limited and shared among the team members (Dwivedula et al., 2016). Thereafter, was illustrated by (Bellotti and Bly, 1996) that mobility is a key factor for the project members to utilize the shared resources in addition with the requirement of effective communication so as to minimize the negative effect of resource constraint on performance through collaborative efforts. Furthermore, (Morgan and Bowers, 1995) have defined that clarity of goals is another antecedent of the project's performance because it will help them to understand the problem and then effectively communicate it to other members so as to devise the best possible strategy to resolve the relative complex situation through coordination and teamwork.

Convincingly, researchers have argued that job description (specifically task complexity) of project team members have constrained them to share their knowledge with each other (Foss et al., 2009). (Van Den Hooff and De Ridder, 2004) evidenced that information sharing requires effective communication channels so as to clearly converse the required information among the team members. (Learned et al., 1997) substantiated that complex system and tasks faced require joint decisions in order to evaluate each possible option. Complex decisions needs to be made in firms and for that purpose, trust is the base to make such decisions and actions (Edelenbos and Klijn, 2007; Joshi and Stump, 1999).

A plethora of researches have substantiated that the communication assist to build a strong collaborated team, therefore, these school of thoughts directed our research to hypothesize that:

H5: *Team Communication moderates the relationship between project complexity and team collaboration such that the presence of team communication strengthens the relationship.*

2.10   Research Model

2.10 Research Model
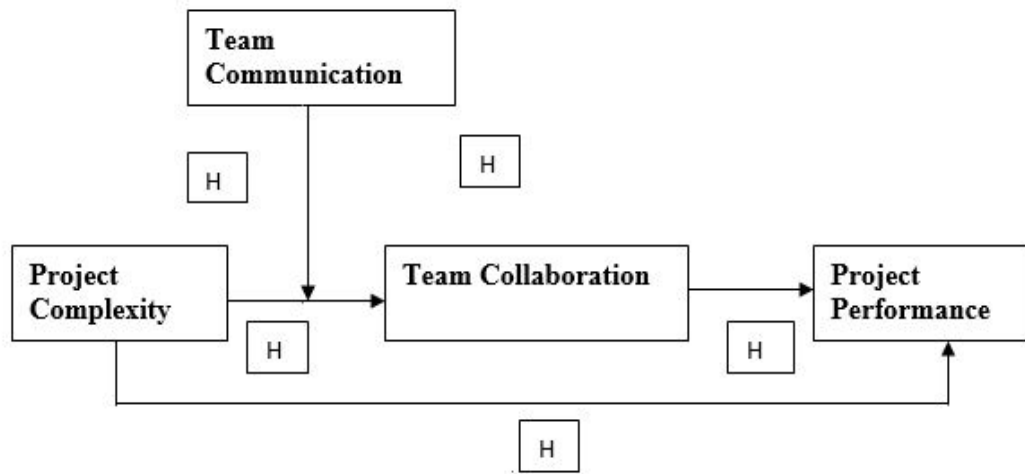
FIGURE 2.1: *Research Model of Project Complexity Impact on Project Performance Through Team Collaboration Moderation of Team Communication*

2.11   Research Hypothesis

H$_1$: There is a negative association between project complexity and project performance.

H$_2$: There is a positive association between project complexity and team collaboration.

H$_3$: Team collaboration is positively associated to project performance.

H$_4$: Team Collaboration mediates between project complexity and project performance.

H$_5$: Effective Team Communication moderates the relationship between project complexity and team collaboration such that the presence of team communication strengthens the relationship.

Chapter 3

Research Methodology

The following chapter is comprised of the details regarding the methodologies and measures used to acquire valid results. The argument covers all the particulars regarding type of study, unit of analysis, population and sampling details, measures and their respective reliability indexes along with the items involved in the conducted research.

3.1 Research Design

3.1.1 Type of Study

The present study is carried out to demonstrate the impact of project complexity on its respective performance by studying the co-relational effect between the two. To carry out the research, projectized organizations tends to be the target population of the research so as to collect the data required for the reliable results. Primarily 400 questionnaires were distributed, but 289 authentic responses were received. The sample of the study is presumed to correspond to the overall population of projectized organizations Pakistan. This assumption will assist to generalize the results of this study and will be understood that sample characteristics are to be exhibited by the population members as well.

3.1.2 Research Philosophy and Research Design

This research is following the positivist approach which pursues the hypothetical-deductive (scientific) method that is based on philosophy of finding the reality using data, in which previous research and existing theories were used to support the anticipated hypothesis which will then be tested empirically for authentication of the hypothesis. According to the scientific method, testable statements i.e. hypothesis are framed based on the existing literature that can be accepted or rejected by applying different statistical results on the collected data against the items used to measure the relative anticipated statements. If the results of statistical tests are opposing the proposed hypothesis, the hypothesis is said to be rejected otherwise accepted as per the supported theory and concept. It is then proposed to compare the descriptive value of competing hypotheses by testing how strongly they are authenticated by their predictions.

As to reach a large scale of population, generally quantitative methods are used and valued. Hence, in this research quantitative research has been utilized in order to collect the quality data for the purpose of associating variables to each other and for demonstrating the nature of association between the variables of the research.

3.1.3 Unit of Analysis

Generally unit of analysis is the most important characteristic in any research study. In research study, unit of analysis can range from an individual to different groups, organizations, cultures etc. Since this study is designed to know the impact of project complexity on its performance, therefore the unit of analysis was the employees of project based organizations out of which most of the projects assessed were the part of IT industry as the relative projects were marked as critical based on the complexity feature and collaboration was needed to execute the project.

In order to evaluate the impact of complexity in projects through employees, study needed to approach the specific sector of project based organization which were facing problems related delays or cost over-run etc. due to complex and uncertain

circumstances during the project execution. To assess the performance of the projects the stakeholders who eventually benefited from the projects were taken as the unit of analysis.

3.1.4 Time Horizon

The present study is not time-lagged study and the data were collected in four weeks' time. All of the data were collected at one time.

3.2 Population and Sample

Since the present study seeks to focus on projectized organizations in Pakistan, the population of the study is the managers, subordinates and the stakeholders (end-users) of this sector. For the current study, data were obtained from project based organizations operating in Islamabad and Rawalpindi. These include both National level and international level project based organizations, running various projects in the field of information technology, infrastructure, education, energy, hydropower, social services etc. There were many projects under different programs going on within the organization but the data is collected from the project teams and the relevant stakeholders of the projects.

3.3 Sample and Sampling Technique

Being aware of the fact of difficulty in data collection process and is known that data gathering from the entire population is not possible due to certain constraints like limited time and resource scarcity, sampling is the commonly used procedure for data collection. For this, a specific group of people are chosen that are the true representatives of the whole population. For the present study, generally, only project based organizations of Pakistan were approached.

The data on independent variable (i.e., Project Complexity), moderator (Team Communication) as well as the mediating variable (i.e., Team Collaboration) were

reported by the projects core team members who had a direct impact on the project performance, including the project leaders, team leaders, and advisors/experts. However, support staff was excluded from this group. The data on project performance has been obtained from key stakeholders i.e., the stakeholders who are the end users of the product or service being produced by the project. The sample mainly consists of managerial and operational level of different organizations and also the counterparts who actually benefited from the project.

Almost 400 questionnaires were disseminated for data collection; however, 289 complete responses were received for analysis. For reporting purposes, the data on project performance obtained from stakeholders were merged and described as averages, which indicated that no threat of common method variance exists. The convenience sampling technique was used due to time limitations. Convenience sampling is one of the techniques of non-probability sampling technique, in which data is collected randomly based on the feasibility to collect data effectively. Hence, Convenience sampling is the most appropriate technique to be used in this research because through this technique data can be collected from the project based organizations of Pakistan randomly, that will depict the most genuine picture of the whole population in demonstrating the impact of project complexity on project performance through team collaboration and communication. These include both national level and international level project based organizations including cultural diversity in workforce, running various projects in the field of infrastructure, healthcare, education, energy, hydropower, social services etc. The organizations were NESCOM, Al-Haseeb Engineering Associates (Pvt) Ltd., Attock Refinery Limited, Apollo, Sky Scrapers, EMumba, ICRC, Telecom Companies like Telenor, Ufone etc., IT Sol Hub, Ministry of Defense and many other organizations that carry out different projects in different fields.

The cover letter unequivocally demonstrated that the examination is being led for scholastic research purposes just and is gone for giving clear comprehension of the elements i.e. project complexity, team collaboration and communication with their influence on the project performance. Respondents were guaranteed of the

privacy of their reactions and namelessness so the respondents don't hesitate to fill in the survey decisively.

3.3.1 Sample Characteristics

The table below represents the sample characteristics of the present study.

3.3.2 Gender

TABLE 3.1: Gender

	Frequency	Valid Percent	Cumulative Percent
Male	178	61.6	61.6
Female	111	38.4	100
Total	289	100	

Table 3.1 First table represents the gender percentages of the study where 61.6% were male and 38.4% were female. The percentage of male respondents is high as compared to percentage of female. .

3.3.3 Age

TABLE 3.2: Age

	Frequency	Valid Percent	Cumulative Percent
18 − 25	84	29.1	29.1
26 − 33	86	29.9	58.8
34 − 41	74	25.6	84.4
42 − 49	35	12.1	96.5
50 and above	10	3.5	100
Total	289	100	

Table 3.2 Table 2 shows the composition of the sample with reference to age groups. 29.1% of respondents age were 18 - 25, 29.9% respondents age were 26

- 33 range, 25.6% respondents age were in 34 - 41 range, 12.1% respondents age were in 42 - 49 range and just 3.5% respondents were more than 50 years. In that study, the percentage of 26 - 33 respondents is greater than other.

3.3.4 Qualification

TABLE 3.3: Qualification

	Frequency	Valid Percent	Cumulative Percent
Metric	0	0	0
Intermediate	11	3.8	3.8
Bachelor	108	37.4	41.2
Master	89	30.8	72
MS/M.Phil.	73	25.3	97.2
PhD	8	2.8	100
Total	289	100	

Table 3.3 Table 3 represents the qualification of the respondents, 3.8% were Intermediate qualified, 37.4% were Bachelors qualified, 30.8% were Masters qualified, 25.3% were MS/M. Phil qualified and 2.8% were PhD qualified. The large number of responses were having a Bachelor's degree.

3.3.5 Experience

TABLE 3.4: Experience

	Frequency	Valid Percent	Cumulative Percent
0 − 5	133	46	46
6 − 10	85	29.4	75.4
11 − 16	46	15.9	91.3
17 − 22	10	3.5	94.8
23 − 28	11	3.8	98.6
29 and above	4	1.4	100
Total	289	100	

Table 3.4 Table 4 represent that 46.0% of the persons having job expertise range from (0 - 5) years, 29.4% of persons having job expertise range from (6 - 10)

years, 15.9% of persons having job expertise range from (11 - 16) years, 3.5 of respondents having job expertise range from (17 - 22) years, 3.8 of respondents having job expertise range from (23 - 28) years and 1.4% of respondents having work expertise more than 29 years. Most of the respondents were lying in the work expertise of (0 – 5) and (6 - 10) years.

3.4 Instrumentation

3.4.1 Measures

The data will be collected through adopted questionnaires from both manual and online sources. The nature of the items included in the questionnaire is such that all of them i.e. project complexity, team collaboration, team communication, trust and project performance are evaluated by the managers and their subordinates. All the items in the questionnaire were responded using a 5-points Likert-scale where 1 (strongly disagree) to 5 (strongly agree), unless otherwise stated. Questionnaires also consist of four demographic variables which include information regarding the respondent Gender, Age, Qualification and Experience.

3.4.2 Project Complexity

The scale is adopted by (Bjorvatn and Wald, 2018), which was based on (Geraldi et al., 2011), who described complexity with reference to arrangement and ambiguity. The responses will be obtained through 5 point Likert scale ranging from 1= strongly disagree to 5= strongly agree. The sample item is "To me, the project had a high degree of complexity concerning content".

3.4.3 Team Communication

Communication scale is adopted from (Barrick et al., 2007), and is used to measure the communication among team members. The responses will be obtained through 5 point Likert scale ranging from 1= strongly disagree to 5= strongly agree. The

sample items include "When members talk to each other, there is a great deal of understanding" and "Team members are comfortable talking to each other about what needs to be done".

3.4.4   Team Collaboration

Collaboration scale is adopted from (Simatupang and Sridharan, 2005) and is used to measure the collaboration. The responses will be obtained through 5 point Likert scale ranging from 1= strongly disagree to 5= strongly agree. The sample items include "The team exchanges the relevant information", "We jointly work out solutions" and "We share any risks that can occur in the project".

3.4.5   Project Performance

The scale is adopted by (Gu et al., 2014) to measure the performance of the project with adherence to basic limitations of the latter. The responses will be obtained through 5 point Likert scale ranging from 1= strongly disagree to 5= strongly agree so as to gauge whether a project produces high quality deliverables in an efficient manner. Sample items to measure the performance of the projects include "Projects are completed on time" and "Projects met budget requirements".

TABLE 3.5: Instruments

Variables	Source	Items
Project Complexity (IV)	Bjorvtan and Wald (2018)	3
Team Collaboration	Simatupang and Sridharan	13
(Med)	-2005	
Project performance (DV)	Gu, Hoffman and Schniedrjans (2014)	8
Team Communication (Mod)	Barrick et al. (2007)	4

3.5   Pilot Testing

In order to carry out the research on a larger scale, pilot testing is always preferred and is considered as a practical approach so as to avoid risks and ineffective consumption of resources and time. Therefore, Pilot testing is done on 40 questionnaires to know about the compliance of data with the proposed hypothesis. Reliabilities of the scales tends out to be in the acceptable range when tested and was determined that there are no significant problems in the obtained data.

3.6   Measurement Model

Confirmatory Factor Analysis (CFA) approach was followed for authenticating the measurement model, which consisted of latent variables: Team complexity, Team communication, Team collaboration and Team performance. The combination of different of Root mean square error of approximation (RMSEA) along with incremental fit index (IFI), Tucker-Lewis index (TLI), and comparative fit index (CFI) was used to assess the model fit.

3.7   Confirmatory Factor Analysis

The measurement model proved to be a good fit to the data. (χ^2/df=1.32, IFI=0.886; TLI=0.898; CFI=0.906; RMSEA=0.051) shown in table 6. The results of CFA confirmed by showing discriminate validity. The satisfactory level is 0.05 to 0.10 (ideal) for RMSEA. CFA for complete model is shown in figure below:

TABLE 3.6: Measurement Model

Model	Factors	χ^2	Df	RMESA	IFI	TLI	CFI
Hypothesized model	Four factors	105.04***	79	0.051	0.886	0.898	0.906
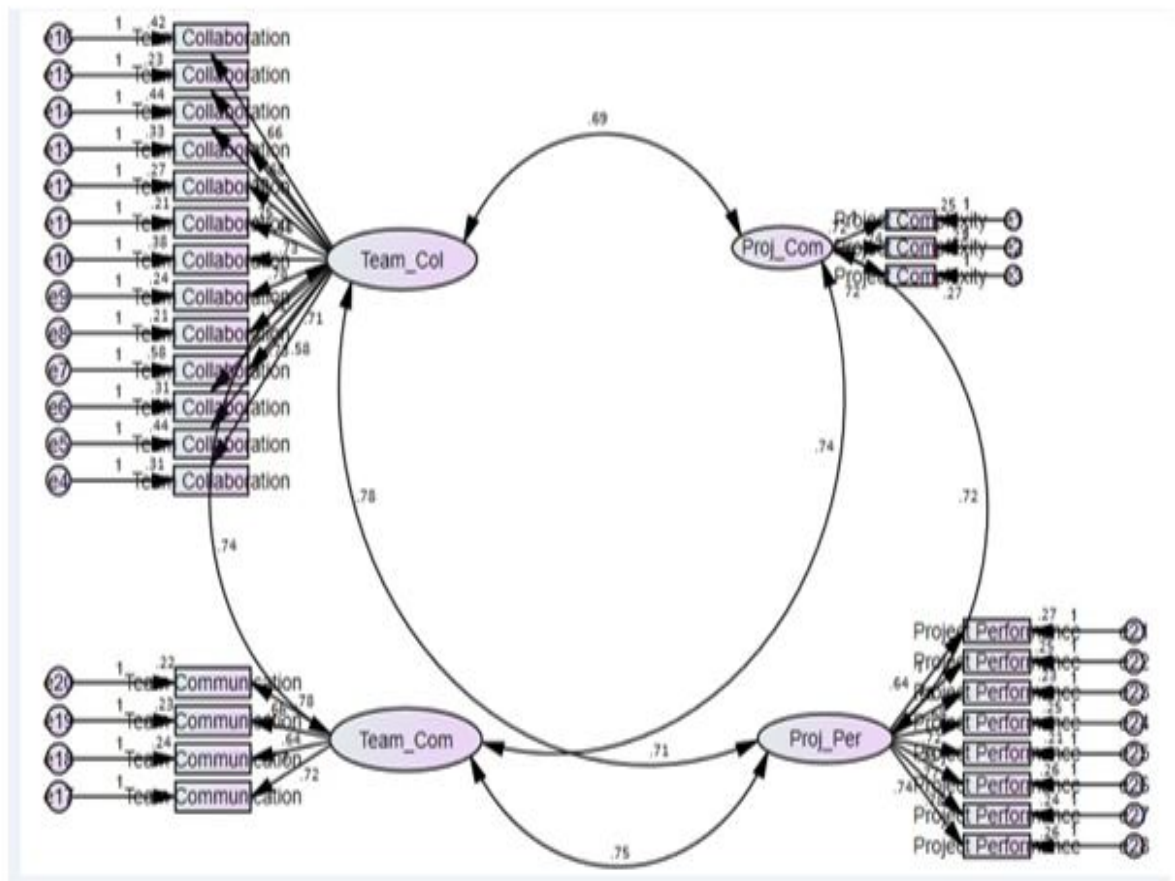
3.8   Covariates

We used One-Way ANOVA test in order to know the control variables for the present study that may affect the outcome variable along with the effect of the predictor. The result showed non-significant difference in project performance across gender (F=0.334, $p > 0.05$), $age(F = 1.839, p > 0.05), qualification(F = 0.816, p > 0.05) and experience(F = 0.206, p > 0.05), hence having no control variable$ for the present study.

TABLE 3.7: Covariates

Covariates	*F Value*	*Sig.*
Gender	0.334	0.564
Age	1.839	0.121
Qualification	0.816	0.516
Experience	0.206	0.96

3.9 Reliability Analysis

The concept of reliability is referred to as producing the consistent results over different intervals of time. Reliability in research is defined as the consistency among the results produced by the particular result when tested in different time frames. It is measured by using Cronbach's alpha test where (Nunnally and Bernstein, 1994) explained the standard of Cronbach's Alpha is more or equal 0.70. In Table 7, the reliabilities of the variables used in the research and the Cronbach's alpha reliabilities for project complexity, team collaboration, team communication and project performance were reported as 0.717, 0.814, 0.710 and 0.809 respectively.

TABLE 3.8: Reliability Analysis

Variables	Items	Cronbach's Alpha
Project Complexity (IV)	3	0.717
Team Collaboration (Med)	13	0.814
Project performance (DV)	8	0.809
Team Communication (Mod)	4	0.71

3.10　Data Analysis Techniques

After the collection of the data that is relevant to the study from 289 respondents, the data was then analyzed on SPSS software version 20. A number of procedures while analyzing the data are used, such procedures are as following:

1. First of all, only the questionnaires which were filled appropriately were selected for the analysis.

2. Each variable of the questionnaire were coded and each coded variable was used for data analysis.

3. Sample characteristics were reported using frequency tables. 4. Descriptive statistics was conducted by using the numerical values.

5. Variable's reliability of the model were checked by co-efficient of Cronbach's alpha.

6. Measurement Model fitness is validated by Confirmatory Factor Analysis (CFA).

7. To substantiate the significant relationship between the studied variables, co-relation analysis was conducted.

8. Single linear regression analysis of Independent and Dependent variable was conducted to determine the proposed relationship.

9. Preacher and Hayes Process were used for conducting mediation and moderation to determine the existence of the role of mediator and moderator between the Independent and dependent variables.

10. Through correlation and Preacher and Hayes method, the intended hypotheses were tested to check the rejection and acceptance of the proposed hypothesis.

Chapter 4

Results

4.1 Correlation Analysis

Correlation analysis is carried out in order to determine the association among the variables that if the variables vary together at the same time or not. In this current research work, objective to find out the correlation between project complexity, and project performance with the mediating role of team collaboration and moderating role of team communication.

Correlation analysis is carried out in order to know about the nature of disparity between the two variables i.e. if the variables vary at the same time or not. Correlation analysis does not necessitate the relationship between two or more than two variables as of Regression analysis.

In correlation analysis, Pearson correlation analysis tells about the strength and nature of the relationship through Pearson correlation range i.e. from -0.1 to 0.1. Hence, through magnitude value we can conclude the strength of the relationship between two variables and that magnitude value can generalize by the distance of correlation from zero.

If the correlation is distant from zero that means the relation between the two variables is strong and vice versa. The zero correlation value means that the two variables do not have any relationship between them. Positive and negative sign depicts the nature of the relationship i.e. the positive sign of the co-relation

coefficient explains the direct relationship between two variables and is explained as the increase in one variable brings an increase in the second variable and vice versa, thereafter, in the same way the negative sign of the co-efficient depicts the indirect relationship between the variables such as the increase in 1st variable brings a decreasing effect in the 2nd variable.

The below mentioned table shows the correlation between the variables that are being studied under this study. And the values of correlation are depicting the nature and magnitude of relationship between the variables.

TABLE 4.1: Correlation Analysis

Sr. No.	Variables	1	2	3	4
1	**Project Performance**	(0.809)			
2	**Project Complexity**	-.129**	(0.717)		
3	**Team Collaboration**	.709**	.200**	(0.71)	
4	**Team Communication**	.705**	.100**	.764**	(0.809)

Alpha reliabilities are given in parenthesis **Correlation is significant at the 0.01 level (2-tailed). N=180. *P< 0.05, $** P < 0.01, *** P < 0.001$.

Table 4.1 presents the correlations for all theoretical variables. Project Performance is negatively and significantly correlated with Project Complexity (r=-.129, $p < .01), Team communication (r = .705, p < .01) and Team Collaboration$ (r=.709, $p < .01). Project Complexity is significantly correlated with Team$ Collaboration (r=.20**, $p < .01) and Team Communication (r = .10 **, p < .01)$.

Team Collaboration is positively and significantly correlated with Team Communication (r=.764**,$p < .01$).

4.2 Descriptive Analysis

The Descriptive analysis tells us about the summary statistics for different variables in table and their standardized values. It includes basic details like sample

size, minimum and maximum values, mean values and standard deviation of the data. Descriptive statistics of the current data were given in Table 9. Initial column of the table presents the details of the variables. Second, third, fourth, fifth and sixth columns inform about sample size, minimum, maximum value, mean and standard deviation respectively. All variables (Project Complexity, Team Collaboration, Team Communication and Project Performance) were rated on a five point Likert scale, such as (1 representing "Strongly Disagree" and 5 representing "Strongly Agree"). Mean values show the core of responses. The mean values of the Project Complexity were 3.30which shows that respondents were agreed, the mean of team collaboration were 3.51 which indicates that respondents were agreed. The mean values of Team communication were 3.70 which indicate that respondents were agreed that they communication environment among team members. Finally, the mean value of Project Performance was 3.56 which indicate that respondents were agreed about the better project performance.

TABLE 4.2: Descriptive Analysis

Variable	Sample Size	Minimum	Maximum	Mean	Std. Deviation
Project Complexity	289	1	5	3.3	0.74
Team Collaboration	289	1	5	3.51	0.47
Team Communication	289	1	5	3.7	0.57
Project Performance	289	1	5	3.56	0.54

4.3 Regression Analysis

To confirm the existence of relationship between the variables, co-relation analysis has been carried out which shows that variables are related to each other but only co-relation analysis is not adequate because it shows only the existence of the association between the studied variables and do not provide passable support to explain the causal relationship between the variables. Therefore, regression

analysis is carried out in order to authenticate the dependence of one variable on other variable. Regression analysis illustrates the extent to which one variable is dependent (dependent variable) on other variable (independent variable) when it is being regressed.

In the present study, (Preacher and Hayes, 2004) methods have been used for both mediation and moderation analysis. Model 4 is used for mediation analysis and Model 1 for moderation analysis in (Preacher and Hayes, 2004) process.

TABLE 4.3: Regression of Outcome

Predictor	Team Collaboration			Project Performance		
	β	R2	ΔR2	β	R2	ΔR2
IV: Project Complexity Step 1						
Project Complexity	0.188***	0.032	0.013*	-0.129*	0.059	0.078***
Med: Team Collaboration Step 1						
Team Collaboration				0.802***	0.502	0.12*

Regression coefficient reported. N = 289, * $p < .05; **p < .01; ***p < .001$

H1: Project Complexity and Project Performance

The above table indicates the results of testing the hypothesis. First, H1 was tested that complexity of the project is negatively associated with the performance. Results indicated that there is a negative as well as significant relationship between the two variables i.e. complexity and performance of the project. The β co-efficient value is-0.129, $R^2 = 0.059$ with the significance value p = 0.02. The value of R^2 shows the determination co-efficient whereas the β value shows the rate of change in the dependent variable due to one unit increase in independent variable. The results shows that almost 13 percent of change is observed in dependent variable with the significance value of 0.02. Therefore H1 is supported by the data collected.

H2: Project Complexity and Team Collaboration

In Hypothesis H2 we assumed that project complexity is positively associated with team collaboration. The regression results of this hypothesis are given in Table 4.3. Results of regression analysis revealed that there is positive and significant relationship existing between project complexity and team collaboration. The β co-efficient value is 0.188, $R^2 = 0.203$ with the p value = 0.000. The value of R2 shows coefficient of determination whereas β value shows the rate of change demonstrating that 1 unit change in project complexity leads to 19 unit change in team collaboration. The p value of 0.000 indicates that relationship is highly significant. Hence, Hypothesis 2 is accepted.

H3: Team Collaboration and Project Performance

In Hypothesis H3 we assumed that team collaboration is positively associated with project performance. The regression results of this hypothesis are given in Table 4.3. Results of regression analysis revealed that there is positive and significant relationship existing between team collaboration and project performance. The β co-efficient value is 0.802, $R^2 = 0.502$ with the p value = 0.000. The value of R^2 shows coefficient of determination whereas β value shows the rate of change demonstrating that 1 unit change in team collaboration leads to 80% change in project performance. The p value of 0.000 indicates that relationship is highly significant. Hence, Hypothesis 3 is accepted.

4.4 Mediation Analysis Results

Hypothesis 4 proposed that Team Collaboration plays a mediating role between Project Complexity and Project Performance. To test the mediation hypothesis, Model 4 of Process Macro of SPSS was used which was used by Preacher and (Preacher and Hayes, 2004). According to Preacher and Hayes direct, total and indirect effects needs to be substantiated when a, b, c and c' paths were tested.
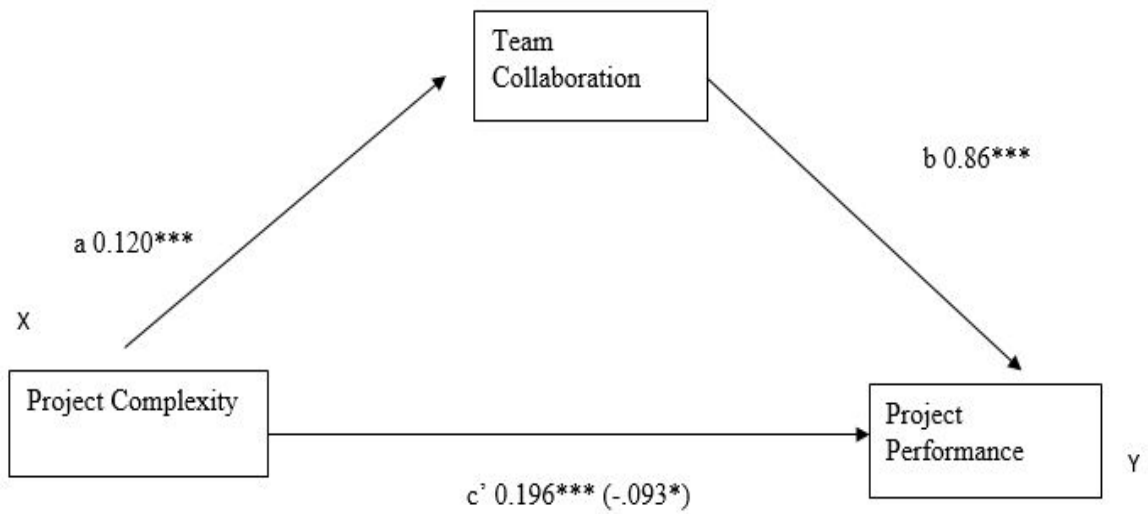
FIGURE 4.1: *Mediation Analysis*

TABLE 4.4: Mediation Analysis

DV	Effect of IV on M		Effect of M on DV		Total Effect of IV on DV		Direct Effect of IV on DV		Bootstrap results for indirect effects	
	(a path)		(b path)		(c path)		(c path)			
	β	T	β	T	β	T	β	T	LLCI 95% PC	ULCI 95% PC
PC	.120***	3.24	.86**	9.32	-.093*	-2.20	.196	6.91	.0068	.2289

Un-standardized regression coefficient reported. Bootstrap sample size was 5000. Confidence Interval = 95%. N = 289, * $p < .05; ** p < .01; *** p < .001 LLCI = Lower Limit Confidence Interval; ULCI = Upper Limit Confidence Interval.$

Total Effect

Total effect explains the effect of IV i.e. Project Complexity and DV i.e. project performance. The total effect of project complexity on project performance is -0.093 with the significance of p = 0.02. It symbolizes that approximately 10% of the variance is incurred in dependent variable due to 1 unit change in independent variable. The lower limit of bootstrap is -0.1765 whereas the upper limit is -0.0100,

without having any zero between both limits. Hence, H1 is accepted that project complexity is negatively associated with performance of the project.

Direct Effect

Direct effect identifies the effect of IV i.e. Project Complexity on DV aka project performance in the presence of mediator which is Team Collaboration. In the presence of mediator the direct effect is 0.196 with the significant p-value of 0.000. It demonstrates that project complexity covers 19.6% variation of project performance in the presence of team collaboration. The lower limit of bootstrap is 0.14 while the upper limit is 0.25, without having any zero between both limits, which clarifies that the results are significant.

Indirect Effect

Indirect effect identifies that mediation exists between IV and DV i.e. team collaboration mediates the relationship between project complexity and project performance. The bootstrap values are predicting the significant results because there is no zero existing between lower limit i.e. 0.0068 and upper limit i.e. 0.2289. Therefore, results are supporting H4 and this hypothesis is accepted.

TABLE 4.5: Moderation Analysis

DV	Effect of IV on MED		Effect of MOD on MED		Effect of IV x Mod on Med		Bootstrap results for indirect effects	
	β	T	β	T	β	T	LLCI 95% PC	ULCI 95% PC
TC	.79***	7.52	.30**	2.86	-.061*	-2.03	-.1210	-.0021

Un-standardized regression coefficient reported. Bootstrap sample size was 5000. Confidence Interval = 95%. N = 289, Control variables were, Gender, Age, Qualification and Experience, * $p < .05; **p < .01; ***p < .001$.

Table 4.5 exhibits Moderation Analysis. **Hypothesis 5** states that "Team Communication moderates the relationship between project complexity and team collaboration". The result show regression coefficients of Interaction Term (PC x TeC) and Team Collaboration as (β = -0.061, p = 0.04, $\Delta R2$ = 0.005). The

finding show that Team Communication negatively moderates between Project Complexity and Team Collaboration and the relationship is significant because lower limit of bootstrap value is -0.1210 and upper limit value is -0.0021, having the same negative sign between both limits, hence Hypothesis 5 is rejected. The result are shown in the table and also explain the conditional effect.

Figure 4 represents the graphical explanation of rejection of Hypothesis 5. The team communication negatively moderates the relationship between project complexity and project performance.
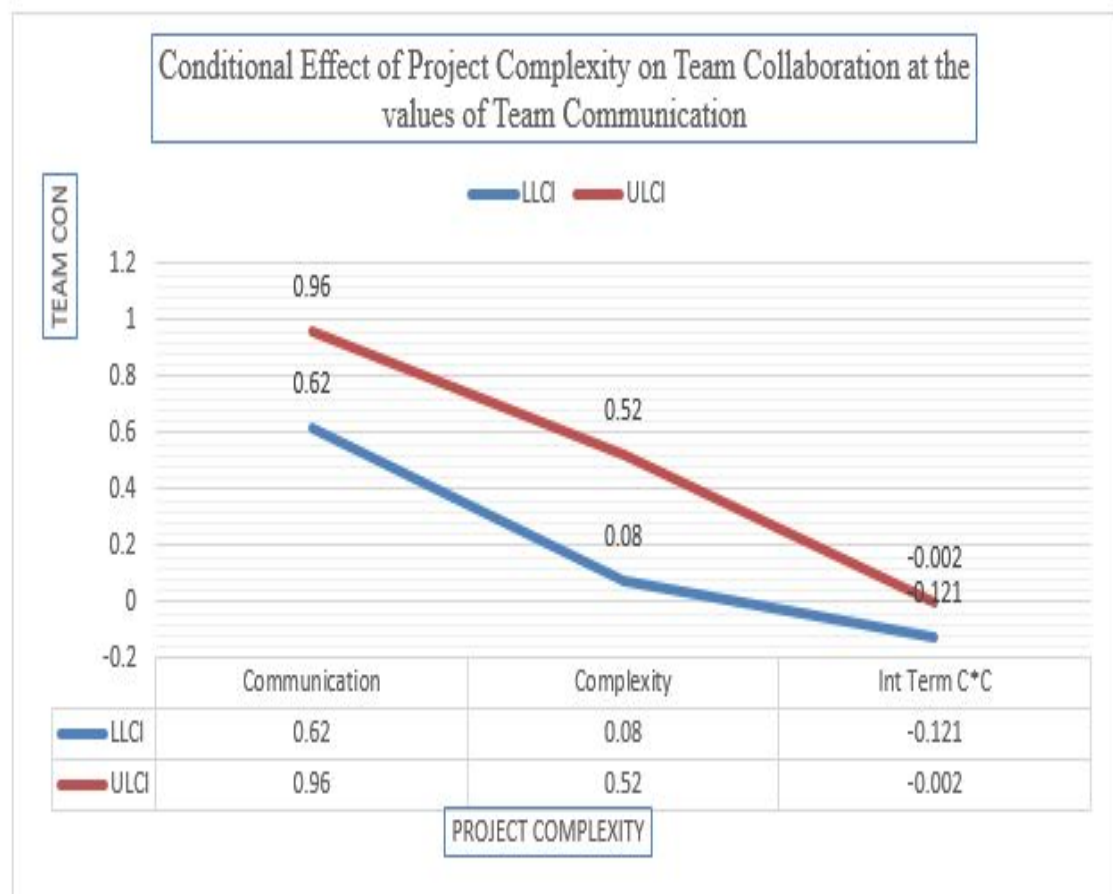
4.5 Summary of Accepted/ Rejected Hypothesis

Table 4.6 illustrates the precise summary of results for the proposed hypotheses under this study.

Table 4.6: Hypotheses Summarized Results

Hypothesis 1	There is negative relationship between Project Complexity and Project Performance.	**Accepted**
Hypothesis 2	There is a positive relationship between Project Complexity and Team Collaboration.	**Accepted**
Hypothesis 3	There is positive association between Team Collaboration and Project Performance.	**Accepted**
Hypothesis 4	Team Collaboration plays a mediating role between Project Complexity and Project Performance.	**Accepted**
Hypothesis 5	Team Communication moderates the relationship between project complexity and team collaboration such that the presence of team communication strengthens the relationship.	**Rejected**

Chapter 5

Discussion

5.1 Discussion

The prior researches within the realm of project complexity and the relative performance are comprehensive and have substantiated their indirect relationship between the two variables (Yang et al., 2014; Laine et al., 2016; Tatikonda and Rosenthal, 2000; Bakhshi et al., 2016). The preceding researches have empirically demonstrated that complexity of the project must be lessen by using the collaborative tools along with the skilled set of expertise of the individuals so as to contribute positively towards the performance of the respective project (Peng et al., 2014; Cicmil and Marshall, 2005; Stokols et al., 2008; Espinosa et al., 2007; Melander and Lakemond, 2015).

The main objective of this research was to study the relationship between project complexity and project performance for the project based organizations within the context of Pakistan's projectized firms. The research also studied the mediating effect of team collaboration between project complexity and project performance. The moderating effect of team communication between project complexity and team collaboration is also studied in the research so as to know its relative impact combined with complexity on project performance.

The analyzed results of the study indicates that project complexity has a negative effect on performance of the project that describes that whenever the complex

situation is encountered during the project life cycle, it proves to be one of the reasons to diminish the performance of the project. The study demonstrated the positive impact of project complexity on team collaboration which further effect positively towards the project performance. Consequently accepting H1, H2, H3 and H4 while developing a positive relationship between project complexity and project performance via team collaboration as a mediator.

The present study introduced the variable of team communication as a moderator. The analyzed data of moderator with reference to the context of Pakistan negatively moderates the relationship between complexity and performance i.e. increase in the effect of communication decreases the effect of collaboration, thereafter, tends to reject the 5th proposed hypothesis i.e, H5. The comprehensive discussion on each of the hypothesis is as following:

5.1.1 Hypothesis H1:There is negative relationship between project complexity and project performance.

In Hypothesis 1, negative relationship between project complexity and project performance was proposed. The results of the hypothesis (=-0.129, p=0.02) proved the existence of the negative relationship between project complexity and project performance. The co-efficient is -0.129 which explains that if there is 1unit increase in the complexity of the project, there will be almost 13% of decrement in the performance of the project.

The results of the present study are in compliance with many of the previously empirical studies supporting the negative and indirect relationship between the complexity of the project and its relative performance (Baccarini, 1996; Yan and Nair, 2016; Yan and Dooley, 2013, 2014; Tatikonda and Rosenthal, 2000; Um and Kim, 2018; Bjorvatn and Wald, 2018). The results of the study suggesting the performance of the project is reduced whenever the complex and uncertain situation is occurred; are also in compliance with the previous research carried out by (Bosch-Rekveldt, 2011) describing that project complexity diminishes the

project performance when it comes to the project constraints i.e. time, cost and scope along with the ambiguity among the goals and targets of the project.

(Floricel et al., 2016) have also substantiated the undisputed results suggesting that the complexity factor of projects are associated with the reduced project performance as per the prediction of the present study. Complexity is one of the innate feature of the projects and is difficult to categorize but always have proved to be negatively associated with the performance of the project (Lessard et al., 2014) and systems (Barclay and Dann, 2000), also, this negative relationship is affirmed by the analyses of the data collected for the present study. It is also suggested by the previous researches that complexity has now become the inseparable component of the project and is one of the causes contributing towards project failure (Bakhshi et al., 2016), hence provide sustainability to the results of the present study.

In today's era of dynamism, the contextual factors play an important role in prediction of the project performance. As far as the culture and environmental factors of Pakistan is concerned, they are quite unpredictable along with the rapid fluctuation in processes and requirements in addition to political and diplomatic instability, projects are become more and more complex and deviating from the approach of linearity towards adaptability and competitiveness, hence also contributing towards the decreasing success rate of projects, especially with respect to the triple constraints of that project.

Continuously evolving market trends and customer requirements are contributing towards the complexity of the project and nepotism being an undeniable fact is also making the projects complex because of the less competent people being the part of project, thereafter diminishing the project performance and decreasing the success rate of the projects that have been implemented so far. (Luo et al., 2016) also substantiated the negative relationship between complexity and performance of projects. The project based organizational setup in Pakistan entails creativity and innovation element along with the mechanisms of adaptability that consequently embed complexity and uncertainty as the antecedents of the performance with a negative impact as suggested by the results of hypothesis (H1). Therefore, the

negative relationship between project complexity and project performance is being corroborated within the contextual settings of Pakistan.

5.1.2 Hypothesis H2: There is positive relationship between Project Complexity and Team Collaboration.

In Hypothesis 2 it was proposed that there is positive association between project complexity and team collaboration. The results of the hypothesis (= 0.188, t = 3.24, p = 0.001) proved the existence of significantly positive relationship between project complexity and team collaboration. The t value of 3.24 indicates the significant level of relationship between complexity of the project and collaboration among the respective team, as the value is greater than 2 means that results are statistically significant. The co-efficient is 0.188 which demonstrates that if there is 1% unit change in project complexity; then there is a likelihood that team collaboration would be increased by almost 19% of units.

Being evident of the fact that projects are carried out to fulfil the novel and transitory purpose hence making complexity as the innate characteristic of the projects and in order to eradicate the passive impact of complexity, collaborative efforts are required by the team members of the relative project team so as to provide creative solution to deal with the uncertain situation (Cicmil and Marshall, 2005; Stokols et al., 2008; Barczak et al., 2010), therefore providing the basis to the findings of the present study that describe the positive effect of project complexity and team collaboration.

Existing empirical researches that are available and explaining the positive relationship between complexity and collaboration are supporting the results obtained by the present study while substantiating the fact that complexity of the project is always cope up by collaborative efforts of the team members (Peng et al., 2014; Uzzi and Spiro, 2005; Walker et al., 2017) also established that collaboration is the optimal strategy to deal with the complex and uncertain situations faced during the project execution time, consequently making the present study results in

compliance with the previous established literatures. Pakistan is a country following the collectivist culture; where the latter focuses on the characteristics of helpfulness and dependability (Anbari, 2018), yet allowing us the propose the relationship between project complexity and team collaboration i.e. whenever team members come across an uncertain or complex situation, they will co-operate and collaborate in order to help each other and overcome the diminishing impact of complexity.

Uncertainty and complexity is considered to be the nature of project and difficulties are encountered dealing with such projects therefore requiring the successful collaborative efforts by the team members in order to decline the undesirable impact of complexity and is established by the study that is being done to know the relationship existence in the context of Pakistan; also, in compliant with the preceding researches that have successfully established the positive association between complexity and collaboration among the team members (Simatupang and Sridharan, 2002; Peng et al., 2014; Tatikonda and Montoya-Weiss, 2001; Yan and Dooley, 2013). Complexity is considered as a challenge by the team members of the project and they co-operate and collaborate in order to minimize the negative consequence of the complexity faced during the project, therefore, complex situations has a positive relationship with team collaboration within the contextual factors of Pakistan.

5.1.3 Hypothesis H3: There is a positive association between team collaboration and project performance.

In Hypothesis 3 it was proposed that there is positive relationship between team collaboration and project performance. The results of the hypothesis (= 0.802, t = 17.01, p = 0.000) proved the existence of significantly positive relationship between team collaboration and project performance. The t value of 17.01 indicates the significant level of relationship between team collaboration and project performance, as the value is greater than 2 means that results are statistically significant. The co-efficient is 0.802 which demonstrates that if there is 1% unit

change in team collaboration then there is a probability that project performance would be increased by almost 80 % units.

The results of this hypothesis are supported by the findings of past researches that considers element of team collaboration as one of the critical factors for enhancing performance of projects (Um and Kim, 2018; Simatupang and Sridharan, 2005; Cao and Zhang, 2011; Sheu et al., 2006). Collaboration takes place when team members alone with their skill set are not able to perform the activities needed to complete the goals and outcomes of the project in order to exploit the unique skills of every individual in the team so as to achieve the milestones through overcoming the lacking knowledge by sharing of the latter with every participant involved (Huxham and Vangen, 2013; Duffy and Fearne, 2004). Therefore, the earlier research results are in compliance with the results of the present study.

The fact that projects are time-bound make it a necessity to have mechanisms that ensure successful and timely adaptability and improvement techniques to be applied according to the demand of circumstances (Davies and Brady, 2016), therefore requiring the strategies as collaborative efforts of the employees in order to meet the deadlines and achieve the targeted milestones so as to positively contribute towards project performance (Olson et al., 2001; Ammeter and Dukerich, 2002; Simatupang and Sridharan, 2005; Yan and Wagner, 2017; Dyer, 1997). Furthermore, the data collected and analyzed for the current study hold up the positive relationship between team collaboration and project performance which is in acquiescence with the above mentioned existing literatures in the respective domain.

The empirical conclusion of the present study is in parallel with the previously established results (Cao and Zhang, 2011), suggesting that the collaborative efforts and activities assist the team members and the organization to contribute positively towards performance by taking right decisions with the input of every individual at right time in order to complete the project in time and gain the competitive advantage over the competitors (Simatupang and Sridharan, 2005) consequently supporting the positive linkage between the collaboration of project team members and project performance.

Project based organizations when endeavor to develop new products or services breeds creativity and complexity within them as one of the innate features and require the joint efforts of the team members in order to share the risk and uncertainty so as to diminish the damaging impact of complexity on performance. The findings of the hypothesis establishes a positive and significant relationship between project complexity and project performance on the basis of data collected from project based organizations in Pakistan.

5.1.4 Hypothesis H4: Team Collaboration plays a mediating role between Project Complexity and Project Performance.

In Hypothesis 4 it was proposed that team collaboration plays a mediating role between project complexity and project performance and this hypothesis has been accepted because results are demonstrating the significant relationship of team collaboration as a mediator between project complexity and project performance, as the lower limit and upper limit 0.01 and 0.23 respectively indicated by the unstandardized regression coefficient are both positive and there is no zero existing in the bootstrapped 95% confidence interval around the indirect effect of relationship of project complexity and project performance through team collaboration.

The project management literature available on critical success factors for projects considers adaptability and innovation as one of the important features contributing in the project success (Di Stefano et al., 2014). It also take into account the fact that creativity is the element recent project based organizations focuses on to gain the competitive edge in the market. The paradigm shift towards globalization makes creativity and innovation as one of the critical factors in order to compete and increase the market share. This creativity breeds complexity and demands for the collaborative efforts of the project members in order to lessen the negative impact of complexity over performance by exploiting the knowledge and experience of every team member and reach to a best possible solution to deal with the

uncertain circumstances and minimizes the risk of deteriorated performance of the project.

The mediating mechanism of team collaboration between complexity and performance is not been studied in the literature of project management. However, (Um and Kim, 2018) have substantiated the fact that whenever a complex situation is faced during the project, it will lead towards the team collaboration so as to elevate the project performance because (Bjorvatn and Wald, 2018) have corroborated that complexity increases delays and budget of the project which are the two main features of project performance.

Inferences of the past literature also suggests that complexity being the intrinsic feature of the project requires team work and efforts in order to enhance the performance of the project (Chiocchio et al., 2011; He et al., 2007). Complexity being one of the inevitable realities of the new venture, require team work and team co-ordination to reduce the negative impact of uncertainty (Fisher et al., 2018) because the preceding researches in this respective domain have established the positive relationship between team co-ordination and collaboration and the project performance (Yang et al., 2011; Gladstein, 1984; Cao and Zhang, 2011; Simatupang and Sridharan, 2005; Dyer, 1997).

It is being verified by many of the project based organizations working in Pakistan that whenever the project is being awarded to the organization, the foremost task is to gather a team best suited for the project. Then the members of the project team identifies the objectives, goals and responsibilities by working together and meet every morning before starting work to know that which team member has completed what amount of task and if anyone needs help in completing the task or not, consequently collaborating in a best possible way to enhance the project performance. Therefore, the mediation of team collaboration between project complexity and performance is accepted and practiced within the contextual settings of Pakistan.

5.1.5 Hypothesis H5: Team Communication moderates the relationship between project complexity and team collaboration such that the presence of team communication strengthens the relationship.

In Hypothesis 5, the moderating effect of team communication between project complexity and team collaboration was studied. The results of Hypothesis 5 showed significant results but in opposite direction of the proposed statement. The analysis showed that there is a significant effect of team communication (= -0.061*, t = -2.03, p = 0.028). The value of = -0.061 predicts that team communication is bringing minimal i.e. 6% change is team collaboration but in the negative direction. The lower and upper limit of -0.1210 and -0.0021 respectively indicated by un-standardized regression are having same signs and zero does not exists in the bootstrapped 95% interval, which means the results are significant. Hence, the results are suggesting that in contrast to strengthening, the communication is weakening the relationship between complexity and collaboration.

In this study we explored the moderating effect of communication on the relationship of project complexity and team collaboration. More specifically, the study was intended to prove that team communication enhances the collaboration of team members when coupled with complexity. But the results of the hypothesis are significant and are demonstrating that when there is the increase in the effect of communication, the effect of collaboration decreases, thereafter leading towards the rejection of hypothesis i.e. H5.

In today's era, we need rapid and innovative development alongside meeting the highest market standards. For this particular reason, teams are not bound to be collocated, rather services are outsourced and virtual teams are created to complete the intended tasks. Virtual team members have differences among them and are not comfortable in communicating other than work; also communication may cause the conflicting situation and have an undesirable impact on their team work and collaboration (Hinds and Bailey, 2003). Furthermore, whenever there is a discussion to reach towards a solution, members have disagreement related to

tasks and sharing of disagreement is mostly not encouraged in teams and effect the members' collaboration in a negative way (Lovelace et al., 2001).

It is also noted that the reaction to complex situation is more important while dealing with it. Also, required communication is being measured by collaboration scale as of information sharing items, therefore extra communication waste the allocated time and cause more ambiguities and conflicts, thus far reducing the collaborative efforts of the team members as per the context of Pakistan. Complex situations in the project are dealt with as a priority, but communicating the information when it is complex or ambiguous or uncertain is not a good idea because it may create more vagueness and difficulties in interpreting the scenario, hence communication negatively effects the relationship between project complexity and team collaboration within the context of Pakistan. It is being noted that team members of the project are also communicating the unnecessary information which is not related to work and consequently delaying their tasks and create a conflicting situation among the team which effects their collaboration in many ways, therefore, team communication as per the context of Pakistan weakens the positive relationship between complexity and collaboration leading towards rejection of hypothesis, H5.

5.2 Practical and Theoretical Implication

The study did significant contributions in the literature both theoretically and practically. The study has contributed towards the literature of variables like project complexity, team collaboration, team communication and project performance. There is meager knowledge available on project complexity with and relationship with collaborative efforts of the members on performance scale of the project. The research is contributing in a way that mediating mechanism of collaboration is not been tested between project complexity and performance, also, contributing within the specific contextual settings of Pakistan with reference to projectized organizations.

The study illustrates very significant actualities by identifying the impact of project complexity on project performance via team collaboration within the collectivist context of Pakistan where team work is always preferred to enhance project performance. The study suggests that uncertainty reduction is mandatory for better performance of the project and is reduced through collaborative efforts of team members. It is being experienced that complexity of the tasks and objectives creates a lot of misunderstanding among the members and it can be minimized by sharing of information and joint decision making by the members, which in turn falls under the collaborative efforts of the team members (Simatupang and Sridharan, 2002; Peng et al., 2014; Yan and Dooley, 2013). Another theoretical contribution is the moderating role of communication between complexity and collaboration, where the data is suggesting that communicating in the complex situation deteriorates the collaborative efforts of the members because complex situations can be interpreted in the opposite way. Also, complexity being the priority, should have been minimized by joint decisions and sharing of the right information, rather than communicating and relationship building between the members. From all the findings of this research, it is evident that by developing the collaborative efforts of team members, project complexity can be cope up with effectively to enhance the project performance. Therefore, it can be substantiated that organizations should focus on supporting the individuals to collaborate effectively so as to cope up with complex situations and elevate the project performance, thereafter contributing significantly towards project management literature.

This study is equally important in the practical business world. In this age of modernization where world is moving rapidly towards globalization, complexity and uncertainty has become one of the evident features of the projects and the organizations need to have strategies in order to cope up with those situations. In the domain of projectized organizations time and innovation leads towards the complexity of the project thereafter making the latter as one of the innate features of project thereafter, the study contribute practically towards the industry that in order to minimize the complexity, collaborative efforts by whole team are required with less of the communication when situation is more complex in order

to avoid misleading details, whereas, the needed information with joint decision making strategy must be followed to let the participants collaborate and elevate the performance of the project. Finally, the research endorsed the fact that high complexity leads towards high collaboration which will enhance the performance of the project by minimizing the direct and negative impact of complexity on performance while mediating the relationship and communication weakens the relationship between complexity and collaboration because ambiguous situations are difficult to communicate and interpret therefore, instead of communicating, collaborating is the strategy needed to augment the project performance. Thereafter, the research contribute practically towards the projectized organizations of Pakistan.

5.3   Limitation of Research

There are always few limitations in research as it is not possible to cover all aspects in one study. This study has filled few research gaps by adding knowledgeable facts in literature. On the other hand, there are some limitations linked with this study because of time and resource constraints. The study is directed only to the project based organizations of Pakistan and the results may not be generalized to other sectors. The target population of the study mainly was the accessible projectized firms leaving many other relevant project based organizations.

Moreover, it was practically not possible to encompass every dimension and abstraction of complexity and collaboration, therefore, generalizability of results is still a question. Additionally we use convenience sampling method and choose the sample which was easily accessible to us which again narrow the probability of results generalization. The results may be different because of strong contextual and situational factors of Pakistani culture, leaving other cultural settings as a limitation of the research.

5.4   Future Research Directions

This research open several novel opportunities for future researches. In this study we empirically tested the impact of project complexity on project performance but in the future researchers can examine the impact of complexity on specific team performance of the complex project with related variables and also used the planning related variables to know that how complexity can effect project planning activities and performance. The current study has focused on project based organizations only, this actually gives a way forward to the researchers examine and replicate the model in organizations (both public and private) other than project based organizations in order to examine the impact of complex situations and performance with a larger sample size.

Moreover, the relationship between project complexity and project performance can be studied with other mediating variables such as training which also positively affect the performance when encountered with complexity. Future researches can also focus on moderating role of other variables between the relationship project complexity and team collaboration. Alongside, moderated mediation, communication can be used as a moderator after mediation i.e. mediated moderation, because after effective collaboration, communication may assist team members to have better team performance as a group. Thereafter, leaving for future researchers to test the moderator that way or other moderators that can strengthen the collaborative efforts. Furthermore, it is being obvious by many of the researches that time is the most critical constraint of projects, therefore, deadline reactivity or time consciousness variables must be considered for future studies in order to know their impact on handling the complex situations and reacting to them within the defined time frame.

In addition, we also suggest further researchers to consider different data collection approaches, as the present study has certain limitations concerning sampling technique used to collect data from the targeted population. The results and significance of the study will be useful for the future researchers focusing on this area to link project complexity to various other variables like staff development. Also

the sample size can be expanded as this study is just limited to easily reachable sample. By incorporating these suggestions, the rejected hypothesis can be re-analyzed and tested, having the probability of producing different results. Hence, upcoming researches possibly can integrate the above mentioned guidelines to contribute towards literature.

5.5 Conclusion

The study is conducted to develop the relationship between project complexity and project performance via team collaboration. Data was collected from Project Based organizations of Pakistan like ARL, IT Sol Hub, Telenor, ICRC etc. through a questionnaire to measure the relationship between project complexity and performance with a mediating role of team collaboration and a moderating role of team communication. Around 400 questionnaires were disseminated, however, only 289 were used for analysis as these questionnaires were having the most appropriate and complete information required for carrying out the analysis for the present study. Statistical tests indicate the validity and reliability of the model variables and the relative fitness. The model is supported by the complexity theory which states that organizations are the complex adaptive systems and needs to be managed through cooperation and coordination. All the hypothesis were accepted apart from for the moderation hypothesis which shows that team communication does not positively moderates the relationship between complexity and collaboration.

This study contributes to the existing literature of project complexity and team collaborative efforts to reduce the consequences of complexity because there is very limited literature available about the studied variables project management literature. This study has corroborated a relationship between complexity and performance through collaboration with in the context of Pakistan's Project Based Organizations.

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Appendix-A

Questionnaire

Dear respondent,

I am a student of MS Project Management Capital University of Sciences Technology, Islamabad. I am conducting a research on the topic: "Impact of Project Complexity on Project Performance with the mediating role of Team Collaboration and moderating role of Team Communication". You can help me by submitting your responses against every question of the questionnaire. I appreciate your participation in my study and I assure that your responses will be held confidential and anonymity will be maintained; also, will only be used for education purposes.

Sincerely,

Amna Zaib

MS Scholar,

Capital University of Sciences and Technology, Islamabad.

Please provide following information.

Section: 1	Demographics
Gender:	1- Male 2- Female
Age:	1 (18-25), 2 (26-33), 3 (34-41), 4 (42-49) 5 (50 and above)
Qualification:	1 (Matric), 2 (Inter), 3 (Bachelor), 4 (Master), 5 (MS/M.Phil), 6 (PhD), 7 (Post PhD)
Experience:	1(0-5), 2(6-10), 3(11-16), 4(17-22), 5(23-28), 6(29 and above)

Please tick the relevant choices: **1= Strongly disagree, 2= Disagree, 3= Neutral, 4= Agree, 5= Strongly Agree**

	Team Collaboration					
1	The team exchange the relevant information	1	2	3	4	5
2	The team exchange the timely information	1	2	3	4	5
3	The team exchange the accurate information	1	2	3	4	5
4	The team exchange the complete information	1	2	3	4	5
5	The team exchange the confidential information	1	2	3	4	5
6	We jointly plan on promotional events	1	2	3	4	5
7	We jointly develop demand forecasts	1	2	3	4	5
8	We jointly manage inventory	1	2	3	4	5
9	We jointly work out solutions	1	2	3	4	5
10	We co-develop systems to evaluate and publicize each other's performance	1	2	3	4	5
11	We share costs (e.g. loss on order changes)	1	2	3	4	5
12	We share benefits (e.g. saving on reduced inventory costs)	1	2	3	4	5
13	We share any risks that can occur in the project	1	2	3	4	5

	Project Complexity					
1	The project had a high degree of complexity concerning content.	1	2	3	4	5
2	To me, the project had a high degree of complexity concerning interdisciplinary participants.	1	2	3	4	5
3	The project was characterized by high risk and uncertainty.	1	2	3	4	5

	Team Communication					
1	Members are willing to share information with other team members about our work.	1	2	3	4	5
2	Members of this team enjoy talking to each other.	1	2	3	4	5
3	When members talk to each other, there is a great deal of understanding.	1	2	3	4	5
4	Team members are comfortable talking to each other about what needs to be done	1	2	3	4	5
	Project Performance					
1	Projects are completed on time.	1	2	3	4	5
2	Projects met budget requirements.	1	2	3	4	5
3	Projects met expectations.	1	2	3	4	5
4	Project team members are satisfied to work together.	1	2	3	4	5
5	Benefits of projects to the organization are high.	1	2	3	4	5
6	Projects resulted in sales growth	1	2	3	4	5
7	Projects helped the organization to increase market share.	1	2	3	4	5
8	Projects helped the organization improve its competitive position.	1	2	3	4	5