

**CAPITAL UNIVERSITY OF SCIENCE AND  
TECHNOLOGY, ISLAMABAD**



**Multi-Dimensional Effect of Innovation Capability on Firm  
Performance with The Mediating Role of Technological  
Innovation and Non-Technological Innovation: An  
Empirical Study on Pakistan's Software Sector**

by

**Mehreen Arif**

A thesis submitted in partial fulfillment for the  
degree of Master of Science

in the

**Faculty of Engineering**

**Department of Mechanical Engineering**

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I would like to dedicate this thesis to my family who supported me through every thick and thin of my life. Especially, my grandparents and parents', as their love and support encouraged me to complete my work.



CAPITAL UNIVERSITY OF SCIENCE & TECHNOLOGY  
ISLAMABAD

**CERTIFICATE OF APPROVAL**

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Performance with The Mediating Role of Technological Innovation  
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Software Sector**

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## *List of Publications*

It is certified that following publication(s) has been successfully submitted online and is presently being given consideration for publications.

1. **Mehreen Arif**, (2018), “Multi-Dimensional Effect of Innovation Capability on Firm Performance with The Mediating Role of Technological Innovation & NonTechnological Innovation: An Empirical Study on Pakistan’s Software Sector”, Engineering Management Journal. ID: EMJ-D-18-00162.

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## *Abstract*

Software firms surely serve to sustain economic growth in developing countries. The challenging competition due to shorten product life cycles, developing technology and changing customer needs acts as major concern for the software sector for which having innovation capability seems to be a pinnacle success factor in such hyper-competitive environment. There is a need to determine the key factors that impact the firm performance. Different software firms that are working in different cities of Pakistan contributed in this survey based study. Current study builds a model related to necessary factors that influence the firm performance such as innovation capability, technological innovations, non-technological innovation and firm performance. The study's main goal is to determine the effect of multi-dimensional variable such as innovation capability on firm performance with the mediating role of technological innovation and non-technological innovation based on an empirical study covering the software sector of Pakistan. Absorptive capacity and strategic orientation, dimensions of innovation capability influence the technological and non-technological innovations in software firms. Study adopted a quantitative approach and gathered 275 usable questionnaires from software firms employees in Pakistan. Findings revealed that innovation capability has a statistical significant relation with firm performance. Additionally, mediating role of technological innovation and non-technological innovation is also established. Results of this study could lead to effective management of innovation capability that improves firm performance by delivering more effective innovation outcomes.

***Key Words:* Innovation Capability, Absorptive Capacity, Strategic Orientation, Technological Innovation, Non-technological Innovation, Firm Performance**

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# Abbreviations

<b>IC</b>	: Innovation Capability
<b>TI</b>	: Technological Innovation
<b>NI</b>	: Non-Technological Innovation
<b>FP</b>	: Firm Performance
<b>RBV</b>	: Resource based view

# Chapter 1

## Introduction

### 1.1 Background

In today's world, competition acts as a bone of contention among the firms and is getting difficult gradually because products life cycles have shortened, technology is developing rapidly and also due to the increase in desire and needs of customers. In order to survive, to grow, to keep up and to sustain performance in such hyper competitive environment, innovation appears to be vital for firms. Firms competing in such dynamic and ever-changing environment are much focusing on innovation as they consider it as a key element of competitiveness (Dervitsiotis, 2010). To achieve sustainable competitive advantage, innovation is a key component for firm that enables it to stand out differently from its rivals. The continued existence of the firm in business depends on the competitive advantages that differentiate it from its competitors. Firms with innovative outputs are able to gain the competitive advantages and they try to sustain it as it helps them to maintain and increase their market share. Many past studies concluded that in order to sustain in the global market place, innovation seems to be a main source that contributes towards firm competitive advantage (Zawislak et al., 2012). The emergence of considerable advanced technologies, extreme global competition and



knowledge economy have seen innovation as a progressive component for competitiveness. According to Kaplan & Warren (2007), innovation is a necessity rather than a luxury. In such changing situation, there is no such industrial player who will refuse to innovate.

Innovation acts as a medium by which firms introduce new processes, new products and such systems that enables them to adapt the changing technologies, modes of competition and changing market (Deborah dougherty & Hardy, 2012). So, innovation is a way to deal with the dynamics of the environment and evolving market. Innovative firms can perform better by improving their performances that makes them more competitive because of the ability to design their products, produce and market them earlier than their rivals. Under the conditions like intense competition, scarce resources, ever-changing customer demands for good quality and dynamic business environment, researchers analyzed that the main component is innovation that enhances firm performance. This leads to their better future productivity (Karlsson & Tavassoli, 2015; Kim soon et al., 2017). According to Kelley & Littman (2006), firms that need to succeed in the competitive environment need much more than a great product that can be a major component of their business success. They need innovation at every point, among all the team members in all aspects of business. Furthermore, firms have to fulfill customers needs better than their rivals by providing a large variety of products. In history different researchers showed different perspectives of innovation like Amabile et al (2007) gave the concept of innovation as successfully implementing creative ideas within an organization. According to Thornhill (2006) innovation begins with new idea that results in introduction of new processes, new products and a new services. In view of Lopez-nicolas (2011) a new or modified production method, management process, policy, plan or a program established in an enterprise is known as innovation.

Innovation capability is the skill to consistently develop new creative and novel thoughts or ideas that brings short term and long term profits for the firms. Many previous studies identified that due to innovation substantial differences exist between the performances of the firms (Huhtala et al., 2014; Karlsson & Tavassoli,

2015; Rajapathirana & Hui, 2018). According to this perspective of difference between the performances of the firms, it is each firm's capability to deal with technological orientation, market orientation and absorptive capacity innovatively which impacts the firm performance. In current study, absorptive capacity and technological orientation and market orientation are studied as dimensions of innovation capability. Absorptive capacity means firm's capability to adapt and obtain new knowledge, integrate it with the previous knowledge to reengineer the process and to develop new applications or introduce innovation based on new knowledge. Technological orientation and market orientation are the configurations of strategic orientation. Strategic orientation is such principle that influences and directs the activities of the firm for better firm performance. According to Deutscher et al (2015), the performance of high technological firms is dependent on different configurations of strategic orientation. In this study, two configurations of strategic orientation such as technological orientation and market orientation are focused. Technological orientation is to get knowledge about new technologies and utilize new technologies and methods for introducing innovation in products and processes. Market orientation is the firm philosophy that mainly focuses on customer, their suggestions and complaints and also to find out what they require and then produce it for them. It is the strategy for competitiveness. Innovation capability seems to be one of the attractive areas that should be examined by the researchers in order to define, examine and categorize its performance impacts. In view of Laforet (2011), innovation depends upon firm's capability to innovate. Innovation is the procedure of equipping new capabilities or improved capabilities. So these capabilities enable a firm to stand out differently from others and obtain a different level of profitability. Business achievements, performance improvements and innovation success are impossible without the application of innovation capabilities in firms and industries (Alegre et al., 2011).

To respond against the changing market environment, innovation capability enables firms to do innovations continuously (Slater et al., 2010). Innovation relies on different kinds of resources such as knowledge and technologies. Innovative firms are capable of using new knowledge and they have the capability to identify

the importance of the new information or knowledge and incorporate it. They are also interested in staying current and learning about new technologies. Firms main focus is to meet the customers needs through its products. This enables the firm to exploit current and future opportunities of growth. So innovation capabilities have a direct impact on the firm learning, growth and innovation performance. Innovative firms perform better than non-innovative firms because they possess such innovative capabilities that enable them to respond to the environmental changes quickly. Such firms invest more in innovation that's why they are more productive (Wadho & Chaudhry, 2018). So, the main area of interest includes the investigation of the association between innovation capability and firm performance. The most critical factor for firm in order to achieve the competitive advantage in extremely unstable market situation is innovation. Innovation capability enables a firm to consecutively do innovation in order to react to the varying market condition (Slater et al., 2010). Innovation capability should be embedded in all the structures, systems and strategies that maintain innovation in a firm (Gloet & Samson, 2016). This ultimately increases the performance of the firm.

## 1.2 Gap Analysis

The sector selected for the current research work is software/IT sector. Software sector is considered as a high technology having characteristics like high rate of innovations, shorter technology life cycles, product value decreasing rapidly that results in shorter product life cycles, global market, high knowledge intensity and intensive competition worldwide (Nambisan, 2002). Software/IT industry is the fastest growing industry in Pakistan with a lot of potential providing customers with high value services that is creating competition among the firms. Even in financial crisis, Pakistans software/IT industry seems to be the successful sector economically. Globalization, fast changing environment, technological developments and scientific developments provide economic opportunities. Several programs are initiated by the government to encourage the IT based firms to develop software and export it. For freelancing in software development and technology sector,

Pakistan is at the fourth position (Fizza Atique, 2017). Within the developing economies, software sector offers a great prospect for industrial development and economic growth. The software sector can be a leading source of economic growth and employment creation. Software industry does not need more investment or capital to be started. So, for developing countries it seems to be an opportunity as they have limited economic resources (Cspedes, 2002).

Software firms fall in the category of innovative firms because they successfully utilize technologies and organizational and marketing strategies to have a stronger position based on new products. Use of innovation and technology seems to be a competitive tool for them. To explore all the issues related to innovation studies software sector presents a valuable context that's why software sector is selected for the study.

Software industry has the greater potential of growing and economically it is regarded as the successful sector of Pakistan. But with potential, failure is also parallel within the context of Pakistan. Software sector is often known as the heart of information society (Nambisan, 2002). There is the need to identify the perceptions of the employees working in software companies to investigate the multi-dimensional effect of innovation capability on firm performance and also to analyze the positive mediators between them. Moreover, authors conducted research work in specific sectors to determine the impact of innovation capability as Zhao et al. (2005) conducted an exploratory research related to innovation capability on manufacturing sector of Singapore, Margarida Vicente and Jos Lus Abrantes (2015) measured the capability of innovation in exporting firms and Rajapathirana & Hui (2018) conducted an empirical study showing innovation capability is positively related to firm performance covering insurance industry of Sri Lanka. Extensive literature highlights the increased interest of researchers in this domain. The various sectors of different countries are discussed by the scholars but software/IT sector of Pakistan has received no attention in literature. One more reason for selecting software/IT sector as the context of this study is the lack of such studies that highlights the value of software sector.

### 1.3 Problem Statement

With the help of previous studies many research gaps can be tracked as it is the common pool of knowledge. Many scholars in their previous studies emphasized on innovation capability to determine its effect on performance of the firm. In this research work innovation capability is examined as a multi-dimensional variable that was recommended by Rajapathirana & Hui (2017). In Pakistan, no such study is conducted in software/IT sector that examines the link between innovation capability and the performance of firm.

Current research work focuses on absorptive capacity and strategic orientation as a further dimension of innovation capability because these dimensions act as a developing factor of innovation capability and then examines the link of innovation capability with firm learning, growth and innovation performance with mediating effect of technological and non-technological innovations that is not explored in past studies. Here, innovation capability is treated as a multi dimensional independent variable. Proposed research promises to test multi-dimensional impact of innovation capability in software sector of Pakistan. To give evidence in this domain (particularly IC, TI, NI, and FP) is essential. This will provide the convincing grounds for firms to deal with innovation to drive their performance in a better way.

### 1.4 Definitions of Variables

Proposed study will investigate the multi-dimensional effect of innovation capability (independent variable) on firm performance (dependent variable) with the mediating effects of technological and non-technological innovations. Dimensions of innovation capability include absorptive capacity and strategic orientation (technological orientation and market orientation). First step in building the study is

to define all variables that will give the empirical meaning to the theoretical concepts (Wacker, 2004). In other words it means to develop valid and appropriate measures of the variables. All variables included in this study are defined below.

### **1.4.1 Innovation Capability**

Innovation capability means firms capability of producing new products that fulfill the requirements of market and applying appropriate technologies for developing these new products. Success of new products increases the growth which impacts on profits, sales and power of competition for many firms (Battor, 2010). Innovation capability is based upon three things like knowledge, attitude and creativeness. Having knowledge capability means forthcoming with unique ideas by linking different concepts and facts. This is only possible by having a right attitude as an enabler of ideas. Once attitude is right and knowledge is there, creativeness links the concept and facts that's why absorptive capacity and strategic orientation are treated as further dimensions of innovation capability that are defined below.

#### **1.4.1.1 Absorptive Capacity**

Absorptive capacity deals with the quantity of the technological and scientific information that a firm can absorb. Or in other words, it is the firm's ability to recognize, absorb, convert, apply the latest acquired knowledge and commercialize it (Falk & Lim, 2015). Basically it includes absorbing the newly acquired knowledge and to assimilate new knowledge with the previous knowledge for developing new applications and to reengineer the process.

#### **1.4.1.2 Strategic Orientation**

Two constructs of strategic orientation are studied in this research study such as technological orientation and market orientation that are defined below:

#### **1.4.1.2.1 Technological Orientation**

Technological orientation means to integrate the new technologies rapidly or valuing the new technological means of accessing the information. For developing new products, firms utilize advance technologies and advance methods that are directed by technical personnel; towards being interested in learning about new technologies and staying current. This study follows the concept of Atuahene-Gima(2001) regarding technological orientation.

#### **1.4.1.2.2 Market Orientation**

The strategy for competitiveness that efficiently produces right behavior to enhance consumer value and therefore ensure long term outcomes for corporations is known as market orientation. Market orientation is focused on discovering and meeting the ever-changing desires and needs of its customer by providing a large variety of products (Mahmoud Abdulai Mahmoud & Charles Blankson Nana, 2016). In sight of Low et al., (2007) market orientation is not only based on the desirable strategy but also a customer based practice. Market orientation includes the effective and close cross-functional cooperation (Wren et al., 2000). Market oriented firms are committed to their customers being sensitive to their future expectations. For them, customers needs play a vital role in their cost-benefit analysis, as firms believe in life time value of their customers so customer knowledge is shared in all departments. Such firms also follow the strategic moves of their competitors and innovative strategies are developed at the same time.

### **1.4.2 Technological Innovation**

Technological innovations are usually related with product and process innovation. It includes new and improved processes, products and significant technological changes in processes and products. Its main focus is how to incorporate a technology successfully in products and processes. Product innovation and process innovation are the two constructs of technological innovation. Product innovation

is to bring in new products with considerably improved performance that fulfills the customers desires better than the already available products. Process innovation is related to the execution of significantly improved or new methods for production that may include change in working methods, tools and human capital etc. Oke et al., (2007) defined process innovation as the development in system or process and the improvement and creation in techniques.

### **1.4.3 Non-Technological Innovation**

Non-technological innovation is usually associated with organizational wide innovation. The execution of new or improved organizational methods in the business practice of firm is known as organizational innovation. New processes that introduce changes in the firm strategy, systems, administrative procedures, structure and new knowledge approaches for performing the work of management is known as organizational innovation (Damanpour & Aravind, 2012). New production method can increase the productivity but it requires the support of organizational changes.

### **1.4.4 Firm Performance**

Firm performance (learning, growth and innovation performance) contributes in the development of firm. These three factors enable a firm to compete with others and to be more efficient than their competitors at capturing ideas and converting them into products. Firms performance is generally based on level of goal accomplishment (Achrol & Etzel, 2003). Outcomes achieved in fulfilling the external and internal goals of the firm define its performance (Lin et al., 2008).



## 1.5 Research Objectives

Main objective of current research work is to setup and analyze the model that links-multi dimensional variable (innovation capability) with firm performance. Additionally, the mediator nature of variable of technological innovation and non-technological innovation will be taken into account for this study. The proposed relationship between the independent variable (innovation capability), mediating variables (technological innovation, non-technological innovation) and dependent variable (firm performance) is shown in the theoretical model/research framework. Specific objectives of the research are structured as follows:

1. Aim of the study is to blend the supporting literature showing significant relation of innovation capability with firm performance (learning, growth and innovation performance).
2. To investigate the particular positive relation of innovation capability with firm learning, growth and innovation performance covering the Software/IT sector in Pakistan.
3. To examine that absorptive capacity and strategic orientation (technological orientation, market orientation) act as the dimensions of innovation capability.
4. To detect the relationship between the variables (IC, TI, NI and FP) in the contextual setting of Pakistan.
5. The overall objective is to develop and analyze an integrated framework of innovation capability and its effect on firm learning, growth and innovations performance with the mediating aspects of technological innovation (TI) and non-technological innovation (NI) in Software/IT industry of Pakistan.
6. To evaluate the strength of the mediating variables in the Software/IT based firms of Pakistan.

Innovation is not only associated with process and product innovation (technological innovation) but also associated with organizational innovation (non-technological innovation). Previous research shows that there are different types of innovation activities such as new production methods, products, marketing strategies and ways to organize business. Oslo manual consist of strategies for assessing and defining innovation types. Also tells how to compile and use the data that can be a fundamental source to identify innovations and describe them at firms level (Oslo Manual, 2005).

The ultimate reason for taking technological innovation and non-technological innovation as a mediators is that such activities enhance the performance of firm by reducing cost and increasing the demand. As past research identifies that for creating the competitive advantage and appropriate value, two components are important to achieve this outcome. First component is technological innovation capabilities and the other is managerial (non-technological) innovation capabilities (Han & Kim, 1998).

## 1.6 Research Questions

The present study is proposed to find out the answers of the following briefly summarized research questions. As research questions are the core part of the study.

1. Does absorptive capacity and strategic orientation (technological orientation, market orientation) acts as the dimensions of innovation capability?
2. What is the effect of innovation capability on firm performance?
3. Is there any significant relation between innovation capability and technological innovation?
4. Is there any significant relation between innovation capability and non-technological innovation?

5. What is the effect of technological innovation on firm performance and either it mediates the link between innovation capability and firm performance?
6. What is the effect of non-technological innovation on firm performance and either it mediates the link between innovation capability and firm performance?
7. Is there any significant relation between technological innovation and non-technological innovation?

## 1.7 Significance of Study

This research is significant in terms of its theoretical, empirical and practical contributions to the existing body of research knowledge. This study will contribute in identifying impact of innovative capabilities on firms learning, growth and performance. Research will demonstrate that if innovation capabilities really work in improving the firms performance or not. Theoretical contribution includes the support of resource base view (RBV) theory that is used in the study to propose the research framework. Empirical contributions are based on the knowledge that is gained by means of direct observations and experience of employees working in Software/IT based Pakistani firms. The research is also practical one as it contributes to the development of the firm performances in software sector of Pakistan and it is beneficial in terms of competing in such a dynamic and changing environment.

The findings of the study will lead to the benefit of the society as science and technologies are playing an important role in the development of society. Ever-changing customer demands for better and efficient products justifies that there is a need of more effective innovative approaches that will enable the firm to maintain its performance and sustain it. The outcome of the study will provide information about multi-dimensional impact of innovation capability that causes differences between the performances of firms. This study will highlight the important variables that should be considered by the firms if they want to be more competitive.

Through this study, firms will become aware of such practice that keeps you ahead from others.

The current research is designed to investigate the hypothesized link of innovation capability with performance of firm in the context of software/IT based firms in Pakistan and provides numerous ways to these firms to improve their performance in industry. For various disciplines, the association of innovation capability with performance of firm has been an area of interest for decades but to examine or identify the link of innovation capability with firm learning, growth and innovation performance in Pakistan is not considered. Due to the absence of such research, gap exists in this study area and there is a requirement to conduct such study in Pakistan. This is a highly ignored area yet most important. Current study can help to boost or encourage firms to perform innovatively if they want to have higher performance in the industry.

Researchers may find the findings useful as this study will also help them to uncover the critical areas that directly impact the performance of the firms due to which, certain differences exist between the firms. This study would have a contribution in the field of innovation and technology through giving information about the outcomes of using capabilities for firm improvement. In future, researchers can further proceed in this domain. Data produced from this study will provide insight about the factor that contribute in enhancing the firm performances.

Current study is aligned in the following sequence. Chapter 2 is based on review of literature about all the variables included in this research work and hypothesis deduced. It also includes research framework. Past cases regarding innovation capability and its effect on firms performance have been discussed up-to 2018. It provides support to the variables selected for this study. It also provides theoretical support in order to deepen the assumptions. This section will provide the literature related to innovation capability (absorptive capacity and strategic orientation (technological orientation, market orientation)), technological innovation, non-technological innovation and firm performance (learning growth and innovation performance). Chapter 3 describes the research methodologies that include

research design covering research philosophy, research approach, study setting, time horizon and unit of analysis. This chapter is also related to measurements, population and sampling techniques, data collection techniques covering the ethical considerations during the collection of data and sample characteristics and data analysis tools that are utilized for this study. Chapter 4 includes the concluded results of analyzed data. It also includes statistical tests to verify the collected data. Chapter 5 will provide the conclusion about research by discussion of results, study limitations, future suggestions and recommendations for upcoming researchers.

## 1.8 Supporting Theory

The current study focuses on resource based view theory.

### 1.8.1 Resource Based View Theory (RBV)

RBV theory is based on resources for superior firm performance. Resources are the key that enable a firm to gain the competitive advantage and sustain it. Resources are helpful if they contribute in increasing the value that firms provided to their customers. Competitiveness of the firm depends upon the resources that are sustainable, rare and inimitable.

Framework of the research is based on this theory. RBV emphasize the importance of innovation as a source of competitive advantage (Carmeli, 2001). At firm level, to examine the potential benefits of innovation capability, RBV theory can be used (Terziovski, 2010). Absorptive capacity refers to the quantity of science and technical knowledge that a firm can absorb. Knowledge is a valuable resource. Customer knowledge is the external knowledge resource. According to RBV, it is more feasible to exploit the external opportunities for growth. Technology can also serve as a resource for firms. Advanced technologies are utilized by the firms to develop new products that can be cause of competitive advantage. Technology

typically represents the core competencies that can be exploited and leveraged in achieving better firm performance (Grant, 1996; Patel, P., & Pavitt, 1994; Prahalad, C. K., & Hamel, 1990).

RBV views capabilities as the most vital skill that strengthens the development of resources which in return results in firm growth. Two critical assumptions of RBV theory are that resources must be immobile and heterogeneous. Intangible resources such as knowledge and processes are immobile that do not move from one firm to other firm. Technology can be a tangible or intangible resource. Heterogeneous assumption is that the firms possess capabilities, skills and other resources that differ from one firm to another firm. If the resources are same, firm could not use different strategies to compete each other and simply no competitive advantage could be achieved. RBV theory assumes that firms achieve competitive advantage by using different resources. This theory demonstrates the characteristics of firm that includes bundle of capabilities and resources that enables a firm to get competitive advantage and higher performance (Newbert, 2007)

# Chapter 2

## Literature Review

In this chapter, the previous research work on the variables will be thoroughly discussed to present the concept with the theoretical meaning. Moreover, this chapter will also provide the conceptual consideration of the framework along with hypothesis generated for the current research work.

### 2.1 Dimensions of Innovation Capability

Proposed study examines the multi-dimensional aspects of innovation capability that was recommended by Rajapathirana & Hui (2017). Ground theory identified absorptive capacity and strategic orientations (technological orientation and market orientation) as two dimensions of innovation capability. Innovation capability depends upon the knowledge and the skills that are required to create changes which enable a firm to learn new ways of combining its resources that provides long term and short term benefits to an organization (Parashar & Sunil Kumar, 2005).

### 2.1.1 Absorptive Capacity

Absorptive capacity is related to attaining new knowledge from external or internal environment, merge it with the previous knowledge and utilize it to do innovations. It is the central element of knowledge management and innovation (Oehmichen et al., 2008). Use of knowledge for generating new ideas depends upon the personnel capability of the individual (Momeni et al., 2015). Knowledge management leads to the capability to innovate. Knowledge as a resource is a key element for absorptive capacity that maintains the competitive capability and firm innovation (Lau & Lo, 2013). Absorptive capacity is the firms capability to evaluate the importance of new knowledge or information, assimilate it and commercialize it (Falk & Lim, 2015). The transformed knowledge outputs contributes in changing the value of economy (Murovec & Prodan, 2009). Thus absorptive capacity is the firms capability which facilitates its growth to have an impact on utilizing the competitive advantage by escalating its knowledge. Later, this knowledge output will be helpful in recognizing its value (Todorova & Durisin, 2007). Potential and various abilities of firm to innovate are reflected in the concepts of absorptive capacity. According to Parashar & Sunil Kumar (2005), the ability to generate knowledge that gives short term and long term benefits to an organization is known as innovation capability. So knowledge creation perspective is the first level for innovation process that's why absorptive capacity is taken as a dimension of innovation capability. Literature also shows that absorptive capacity is taken as a dimension of innovation capability (Zhang, 2004).

The absorptive capacity of firm will rely on the capability of individuals who stand at the crossroads of the external environment and the firm (Spithoven, 2010). There are two main parts of absorptive capacity. First is previous knowledge that serves as a platform for the accumulation of new knowledge in future. And the second part is the intensity of efforts that includes the effort and the time of firm individuals to enhance the absorptive capacity. According to Newey & Zahra (2009), absorptive capacity enables a firm to convert the knowledge into new services and new products that form a base of innovation. Cohen & Levinthal (1990)



demonstrated that absorptive capacity is not only related to R&D efforts but also the problem solving capacity of firm members, previous learning experience, coordination, a shared language and diversity of firms knowledge base. Later, Zahra & George (2002) linked the set of strategic processes and firm routines with the aim of generating dynamic capability of a firm. In view of Patterson & Ambrosini (2015), dynamic capability identifies, obtains, assimilates, transforms and exploits the external information or knowledge with the internal resource to create new resources for firm that enables innovation, depends on absorptive capacity. Acquisition is the capability to search, value and attain critical external knowledge (Liao & Welsch, 2003). Assimilation is the capability to analyze internalize and assimilate the newly attained information or knowledge (Camisn & Fors, 2010). Transformation is the capability to transform absorbed information or knowledge into routines of firm (Jimnez-Barrionuevo et al., 2011). Exploitation is the capability that enable firms to create new things and to improve, leverage and extend the present competencies by embedding the newly acquired knowledge into its operations (Zahra & George, 2002).

Absorptive capacity involves engaging in new practices, adapting the new practices which are different from the existing ones, the development and the application of the knowledge structure which enables to update the learned practices. Liao & Tsuei (2009) outlined it in only one sentence: If we think organization as a system, knowledge as its input, absorptive capacity is its processing than the output will be innovation capability. Absorptive capacity acts as a dimension of innovation capability, as absorptive capacity enables a firm to acquire new knowledge, combine it with the previous knowledge and use it in the innovation process that may include technological and non-technological innovations.

### **2.1.2 Strategic Orientation**

Strategic orientation is studied using two components such as technological orientation and market orientation. Rajapathirana & Hui (2018) suggested examining

innovation capability as a multi dimensional variable by using technological orientation and market orientation that is the limitation of her research work. In view of Hakala (2011), such principles that gives direction and influence the firm activities and also create behaviors intended to guarantee its performance and viability is known as strategic orientation. Such firms look for new opportunities by engaging them in innovation and these firms most probably achieve a high level of innovation capability. Different types of innovations can be driven by different strategic orientations (Jean et al., 2018). So, strategic orientations influence technological and non-technological innovations. Study of strategic orientation is still escalating with different types of orientations either for firms innovation (Patel et al., 2014) and firms growth (Laukkanen et al., 2013) . In this study, technological orientation and market orientation are discussed as two components of strategic orientation.

#### **2.1.2.1 Technological Orientation**

Technological orientation is related to the adaptation of new technologies. Technologic competence is one of the basic factors of competition. Firms need to maintain and sustain their performance in such environments where technologies frequently or rapidly change. Efforts of developing new technology influence innovation. In view of Kelly (2001), when a firm follows a technological development or it contains the technology oriented activities, such efforts for technology development depends upon its innovation capability. So, technological development is possible if firm has the required capability, thats why it is considered as a domain of innovation capability. Technological changes and commercialization of new technologies results in rapid innovation. Re-engineering of business processes as a result of advanced technology is based on technological orientation. Technological orientation enables the firm to attain new technical knowledge that is necessary for firms to provide solutions for fulfilling new and potential requirements of customers and by means of this newly acquired knowledge, firms build up their new product development capability (Atuahene-Gima, 2001). So, it is the ability of the firm to form a strong technological infrastructure and utilize it for producing new products.

Technology oriented firms create such organizational culture that supports creativity and learning (Ritter, 2002). Such firms exploit innovative and technological opportunities, as they follow the technological developments at close range. Their aims include invention, creativity and to find new techniques, methods and technologies. They have the ability to develop its technology and technological knowledge to respond towards customer claims and needs and also for predicting that. Innovative firms usually undertake complicated and advanced innovation project associated with high risk. For carrying out these innovative projects successfully, they must have a strong innovative capability. Innovative firms have strong technological orientation (Ritter, 2002). To be competitive, these innovative firms consider new markets and new products as an important component. Depending on the synergy created by current products such firms could produce new products easily. Technological orientation enhances the capability of firm that enables it to maintain its position in a competitive environment as it insist firms to actively participate in adopting new technologies for operating procedures and products (Han & Kim, 2008).

#### **2.1.2.2 Market Orientation**

Market orientation is somehow connected with the innovation capability of a firm that's why treated as its dimension. As it is linked with the new product performance of firms in different ways like gathering information about market that enables firm to learn about market changes rapidly and accurately, get familiar about market potential, competition, customers desire and buying behavior of customers which supports the launch and development of new products (Li & Calantone, 1998). For the achievement of competitive advantage, their culture is to support the creation of values and is oriented by the market. Such firms create insights by interacting with customers which helps in developing a competitive marketing strategy by providing superior value to their customers. In achieving the superior market performance different scholars has shown significant interest to examine the role of innovation capability (Li & Mitchell, 2009; Sok et al., 2013).

Market orientation is an important component of firm culture. Firms think about their operations and strategy by keeping customers as a central part as they are focused on creating value for customers. Market orientation acts as a guiding principle whose main focus is market and customer information (Panigyrakis & Theodoridis, 2007). Literature suggests that market orientation is an important market based asset as firms better understands the marketing environment, customers and competitors. Therefore it can contribute in creating high performance of firms (Theodosiou et al., 2012). Four perspectives of market orientation are suggested in the past literature (Demirbag et al., 2006). At first, Gatignon & Xuereb (1997) gave strategic perspective. Secondly, Slater & Narver (1999) presented culture-based behavioral perspective. Thirdly, Jaworski & Kohli (2000) provided market intelligence perspective. Fourthly, customer focused perspective was presented by Li et al., (2006).

Market orientation emphasizes the use of knowledge in the firm which result in increment of performance of new product and innovativeness of the firm while at the same time it provides a proactive position to satisfy the need and desires of customers (Olavarrieta & Friedman, 2008). Market orientation and product innovation are having a significant positive relation (Mu et al., 2016). Market orientation is based on three component that includes customer orientation, inter functional coordination and competitor orientation (G. Akman & C. Yilmaz, 2008). Current study follows the approach of G. Akman & C. Yilmaz (2008), thats why customer orientation, competitor orientation and interventional coordination are taken as furtur dimensions of market orientation. Market oriented firms are more sensitive towards getting opportunities than their competitors whose level of market orientation is low (Micheels & Gow, 2010). They deal with high risks and uncertainties than that of less market-oriented firms (Kohli & Jaworski, 1993). Positive outcomes are expected to be associated with market orientation. Innovative enterprises have strong market orientation due to the success of new product and innovation and they are being oriented mainly by the market (Baker & Sinkula, 2007).

## 2.2 Relationship between Innovation Capability and Technological and Non-Technological Innovations

Innovation capability involves seeking new opportunities, new ideas, resources or knowledge from external environment and endogenous potentials. To improve the competitiveness and to create the added value, firms can exploit them and apply them to the operational system and production process (Amabile, 1988). Its the firms innovation capability to transform these new opportunities, ideas, resources and knowledge or information into new products, new processes and new systems that provide advantage to the firm. And as a result innovation capability affects the firm competitive superiority level in terms of value adding performance by doing technological and non-technological innovations. Firm capabilities are important in implementing the entire strategy, for providing competitive advantage and sustaining it. To attain sustainable competitive advantage, innovation capabilities of firm purposefully create, expand and use its resources according to the market trends and changing needs of the customers (Breznik, 2014). For strengthening the competitive advantage, firms must merge their organizational policies with innovation capabilities to create and commercialize new services and products.

Innovation capability and above discussed dimensions of innovation capability results in technological and non-technological innovation that promotes firms growth. Based on the literature that shows innovation capability enables a firm to do technological and non technological innovation, the proposed hypotheses are:

*H<sub>1</sub>: Innovation Capability has a significant positive impact on Technological Innovation*

*H<sub>2</sub>: Innovation Capability has a significant positive impact on Non-Technological Innovation*

## **2.3 Innovation Capability and Firm Performance**

In view of Teece DJ & Pisano G (1997), innovation capabilities are such abilities possessed by the firms to determine the opportunities and utilize them to enhance the assets. Zaidi AN (2017) mentioned three components of innovation capability such as innovation potential, innovation processes and innovation results. Firms that utilize all these aspects of innovation capability can get successful results as these aspects has positive influence on firm performance. In previous studies, the evaluation criteria of innovation capability is based on different perspectives and researchers tried to identify such capabilities that are required by the firm to innovate (Alves et al., 2011; Forsman, 2011; Wang et al., 2008; Zawiskal et al., 2009; Zawislak et al., 2012). Every firm must have some specific capabilities, as innovation can only take place if the firm has innovation capability which enhances the performance of the firm. Several qualitative and quantitative researchers determined the relation of innovation with firm performance. They concluded innovation has a significant positive relation with firm performance by reducing the lead time, improving the productivity and quality of product (Armbruster et al., 2008; Cainelli wt al., 2004; Cho & Pucik, 2005). According to McAdam & Keogh (2004), in order to get the higher competitive advantage innovation is important for firms.

In view of Lawson & Somson (2001), innovation capability manages and moulds multiple capabilities. To stimulate the innovation successfully, there must be integration between firm resources and key capabilities. For determining the impact of innovation capabilities, firm performance/ business performance is viewed as an important measure of effectiveness of any managerial strategies (Venkatraman & Ramanujam, 1986). Firm performance is like a mirror because outsiders can easily evaluate the ability of firm by seeking its performance (Bonn, 2000). Firm

performance has received much importance and attention in the literature to know about the factors which keep you ahead in the industry. Different variables were used to evaluate the performance of firms that includes its financial performance, market performance, learning performance, growth performance and innovation performance etc. The ability of achieving the projected business outcomes and the success of firms in terms of operational activities and financial activities is known as firm performance (Lonnquist A., 2004; Tangen S., 2005). Performance has many names as a multidimensional construct, includes growth (Wolff & Pett, 2006), learning, innovation, competitiveness and success.

In this research, different factors are used to measure the firm performance such as its learning, growth and innovation performance. These factors are treated as a one variable for determining the firm performance. Growth and learning performance is normally described in terms of customers, employee suggestions and satisfaction and innovation performance is described in terms of number of new products. In this study, firm learning, growth and innovation performance is comprised of employee satisfaction, employee turnover rate, employee suggestions, customer acquisitions and competitor comparison with respect to the products, capturing ideas and innovation. Innovation performance upgrade the position of firm through process based advantaged that with time increase the efficiency of innovation in firm (Rubera G, 2012). Growth is the result of internal organizational methods relative to market place and competitors. Valencia et al., (2010) listed some studies that specified innovation is positively related to firm performance including growth, effectiveness and profitability.

In literature different scholars investigated the association of innovation capability with performance of firm and determined significant positive relation between them (Dadfar et al., 2013; Rajapathirana & Hui, 2018; Saunila & Pekkola, 2014). Firm performance results are proved to be highly satisfactory if the firm comprises of outstanding capabilities reflected through innovation in product development or management and technology forms. Better innovation capability results in better firm performance as previous studies determined a positive relation between innovation capability and business performance (Koellinger, 2008; Tsai, M.T, and

Tsai, 2010). Innovation capability is a firm's exceptional advantage (Guan & Ma, 2003). Different researchers considered innovation capability as a key of competition (Lawrence & Lorsch, 1967). Innovation capability is associated with a novelty for creating and increasing the value for the firm. Therefore, proposed hypothesis is:

*H<sub>3</sub>: Innovation capability has a significant positive impact on Firm Performance*

## **2.4 Mediating Role of Technological Innovation and Non-Technological Innovation**

To improve performance various types of innovation plays a role of mediator which explains the link between innovation and firm performance. Several studies identified the mediating role of innovations by linking different variables like Anningdorson (2017) linked customer involvement capability and the performance of firm, Tseng et al., (2008) related organizational culture and performance of firm and Uzokurt & Kimzan (2017) linked market orientation, environmental uncertainty and firm performance. Innovation also played a mediating role between organizational culture and firm performance that includes market value of firm, profitability and market share (Uzokurt et al., 2013).

Mediating effects of two types of innovations such as technological and non-technological/managerial innovations are investigated in this study. Technological innovations including product innovation and process innovation are taken as a mediator in past studies (Dahiyat, 2017; Markovic & Bagherzadeh, 2018; Sharma et al., 2016). Non-technological innovation/managerial innovation including organizational innovation also played a role of mediator in previous studies (Naghavi et al., 2012; Prange & Carlos, 2017) In this study, technological and non-technological innovations are taken as a mediators that mediate the link of innovation capability with firm learning, growth and innovation performance. Firms adapt to product, organizational and process innovation for satisfying their customers and



for competing with other firms. This study is supported by empirical literature that innovation can improve the performance. Innovation capabilities facilitate the innovation which eventually enhances the overall performance of firm. Different firms have different level of innovation capabilities. Growth of the firms is positively related to the formation of innovations (Varis & Littunen, 2010). Many aspects of innovation capability should be focused including new product, process technologies, organizational and administrative systems (Garcia & Calantone, 2002; Johannessen et al., 2001; Lin & Chen, 2007). Therefore, proposed hypotheses are:

*H<sub>4</sub>: Technological innovation mediates the link between innovation capability and Firm Performance*

*H<sub>5</sub>: Non-Technological Innovation mediated the link between innovation capability and Firm Performance*

## **2.5 Technological Innovations and Firm Performance**

Technological innovations are usually seen encompassing product innovation and process innovation that are correlated to each other (Li et al., 2007).

### **2.5.1 Product Innovation**

Firms do product innovation to introduce efficiency in business processes. Exploiting new ideas leads to product innovation and provide us with the variety of products. Introducing new products or modifying the existing one to fulfill the customer expectations is known as product innovation (Chang et al., 2012; Langley et al., 2005; Polder et al., 2010). The products are significantly improved according to their material, intended use, components and software etc. Attracting new customers is the main aim of product innovation. Creation of the new

products satisfies the current customers and market or it creates new customers or markets (Wan et al., 2005). Product innovation is generally driven by reducing product life cycles, advancing technologies, increasing competition and changing customer needs. It is considered as an ongoing and difficult process that has significant interactions with customers, suppliers and within firm (Gunday et al., 2011). For achieving the successful firm goals, it integrates different capabilities outside and inside the firm.

Product innovation has many perspectives including firm perspective as product is new to the firm, customer perspective as product is new to the customer and product improvement perspective means modifying the existing products of the firm. In terms of expansion and growth in new areas and for gaining the competitive advantage, innovation capability and product innovation are necessary to provide business opportunities (Abu Bakar & Ahmad, 2010). Innovation enhances the quality of the products which as a result improves firm performance and ultimately it serves as the necessary component competitive advantage for firm (Camison & Lopez, 2010). It provides firm with potential protection from competitors and market threats (Hult et al., 2004). Customer future needs facilitates firms with the notification towards new technology and market development; it also raises the firm abilities to utilize these developments in product innovation (Zhang & Duan, 2010). Previous studies concluded product innovation is positively related to the performance of firm (Alegre et al., 2006; Espallardo & Ballester, 2009; Varis & Littunen, 2010).

### **2.5.2 Process Innovation**

Utilization of new and improved devices, techniques, knowledge and tools during a production activity is referred to as process innovation (Langley et al., 2005; Oke et al., 2007; Wan et al., 2005). Process innovation is usually related to improving the technology, production method and equipment or re-engineering operations of firms processes. This includes many aspects of firms functions such as management, commercial activities and R&D. In view of Abdallah & Phan (2007),

process innovation reduces the per unit cost, increases the quality of production, increases efficiency and production. Polder et al., (2010) defined process innovation as a significant improvement in logistic and production methods or improving the supporting activities like computing, maintenance, purchasing and accounting.

Recently Lendel et al., (2015) configured process innovation stages. These stages consist of searching for new ideas and their conversion, diffusion, generation and also identification of new opportunities and customer needs (Bernstein & Singh, 2006; Hansen & Birkinshaw, 2007). In literature, process innovation has gained much value (Lichtenthaler, 2011; Trott & Hartmann, 2009; Van De Vrande et al., 2010). Many researchers concluded that process innovation and firm performance are positively associated together ( Ar, I. M. & Baki, 2011; Morone & Testa, 2008; Varis & Littunen, 2010). Firm are using process innovation with the aim of producing new products and innovative products as well (Hassan et al., 2013). According to Azubuike (2013), technological innovation capabilities contributes towards the potential and efficiency of firm performance. . An innovative capability leads toward innovation which results in enhanced firm performance. Further proceeding after the above discussions, linking two components of technological innovations such as product and process based innovations with performance of firm. The proposed hypothesis is:

*H<sub>6</sub>: Technological innovation has a significant positive impact on Firm Performance*

## **2.6 Non-Technological Innovation and Firm Performance**

Non-technological innovations are usually seen encompassing organizational and market innovation. In this study, only organizational innovation is included.

### 2.6.1 Organizational Innovation

If firms have the capability for organizational innovation, than it has a direct and strong impact on its performance. New practices or ways of organizing routine activities or doing business, new ways to manage the external relations, and decision making systems are regarded as organizational innovation (Polder et al., 2010). These new practices or ways could be developed within the firm or with engagement of third group. Organizational innovation is meant to increase the firms performance by adjusting the internal parameters of firm to the dangers and challenges posed by an international context. Organizational innovation also increases the firm performance by decreasing the administrative and transaction cost. Organizational innovation is helpful in increasing the efficiency of business. Characteristics of innovative organization include empowered employees, absence of strict work rules and flexibility (Daft, 2009).

Chang & Lee (2008) explored link between organizational innovation and performance, concluded a positive relation. Based on result, group oriented teamwork and innovative spirits in organizational culture prove a positive impact on employees satisfaction regarding job. Therefore, based on past literature following hypothesis is developed.

*H<sub>7</sub>: Non-Technological Innovation has a significant positive impact on Firm Performance*

## 2.7 Relationship Between Technological Innovation and Non-technological Innovation

There exists a significant relation between technological innovation (product innovation, process innovation) and non-technological innovation (organizational innovation). Previous research identifies, firms that perform technological innovations usually implement corresponding organizational practices (Caroline Mothe,

2010). Past studies examined the relationship between technological innovation and organizational innovation by highlighting that technological innovation drives organizational changes (Danneels, 2002). Balanced implementation of technological innovations and administrative/ non-technological innovations are more effective in enhancing and preserving the performance of firm rather than implementing them alone. Firms that are not able to restrict the competitive forces by their non-technological innovations are also not able to create appropriate value while having capabilities in technological innovation. According to Ryu HS (2015), interaction between technological innovation and non-technological innovation enables firm to succeed by improving their performance. Firm performance has a strong combine impact of technological innovation and non-technological innovation. Therefore, proposed hypothesis is:

*H<sub>8</sub>: Technological innovation has a significant positive impact on Non-Technological Innovation*

## 2.8 Research Framework

Research framework represents the overall strategy of the study. Different components are used in the study to ensure that the research problem is effectively addressed. Research framework designed for this research work examines the effect of innovation capability on firm learning, growth and innovation performance as shown in Figure 2.1

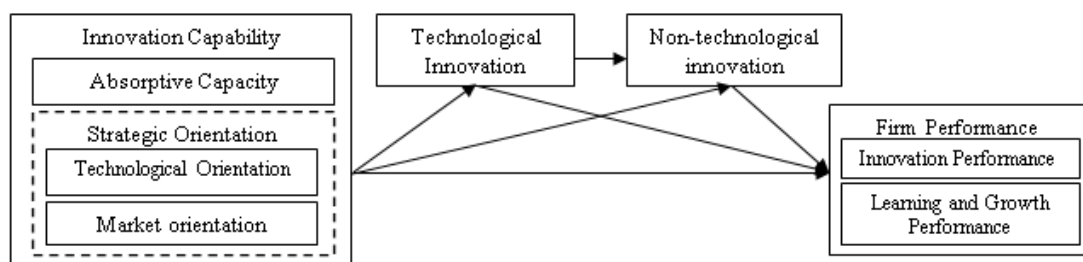


FIGURE 2.1: Research Framework

## 2.9 Summary of Proposed Hypothesis of the Study

$H_1$ : Innovation Capability has a significant positive impact on Technological Innovation

$H_2$ : Innovation Capability has a significant positive impact on Non-Technological Innovation

$H_3$ : Innovation capability has a significant positive impact on Firm Performance

$H_4$ : Technological innovation mediates the link between innovation capability and Firm Performance

$H_5$ : Non-Technological innovation mediated the link between innovation capability and Firm Performance

$H_6$ : Technological innovation has a significant positive impact on Firm Performance

$H_7$ : Non-Technological Innovation has a significant positive impact on Firm Performance

$H_8$ : Technological Innovation has a significant positive impact on Non-Technological Innovation

# Chapter 3

## Research Methodology

Research methodology is the method or procedure used for arriving at results and tools for proving or disproving such knowledge (Nachamias et al., 1996). Methodology related to research design and data collection process is presented in this section.

### 3.1 Research Design

It is a procedure that shows the plan of actions in a research. In view of Zikmund (2003) research design is specified by the researcher that is the method or procedure of collecting data and analyzing it. Research design includes the research philosophy, research approach, time horizon, unit of analysis and study setting.

#### 3.1.1 Research Philosophy

Research philosophy of the research work contains the circle of knowledge in which all paradigms of research elements exist. Research philosophical approaches facilitate to decide which approach is to be adopted and why it is adopted by the researcher, which is derived from the research questions (Saunders et al., 2009).

Positivism, interpretivism, realism and pragmatism are the four types of philosophies that could be adopted (Saunders et al., 2012). This research study is of **positivism** nature as methodology is structured to facilitate the hypothesis and it includes the quantifiable observations according to which statistical analysis is obtained.

### 3.1.2 Research Approach

This study is based on **deductive approach** that usually begins with the hypothesis and its emphasis is on causality. This is a **casual research** design where the effect of innovation capability on firm performance with the mediating effect of technological and non-technological innovations was measured. This is a **quantitative field** research where data was collected through **survey based methodology**.

### 3.1.3 Time Horizon

According to Saunders et al., (2012), time horizon consist of two dimensions; Longitudinal and Cross-sectional. Research studies include Cross-sectional studies and longitudinal studies. Cross sectional study includes time boundaries and is conducted in that specific horizon but longitudinal study is conducted over a long period of time. Data required for this study was collected within two months. So, the nature of current study is **cross-sectional** as it includes time boundaries.

### 3.1.4 Study Setting

The participants for this study include employees working in different software houses and software organizations in Pakistan. They were contacted to fill the questionnaires. For this purpose, three procedures were adopted to get the valid response. One was electronic mail, second was online link and the last one was printed form or hard copies of questionnaire. To fill the survey, self-visit was



made in the software organizations and sectors using references. For this purpose, hard copy of questionnaire was utilized. Questionnaires were filled by software managers, web developers, front-end developers etc. Online link was also generated and most of the responses were collected by using online link. For this purpose, Facebook and LinkedIn apps were used to search the professionals working in software companies of Pakistan. Through electronic emails, different employees were also contacted .

### **3.1.5 Unit of Analysis**

Data to be analyzed is collected from Individuals, organizations, groups, and industry. They all fall in the category of unit of analysis. For this study, the unit of analysis was software/IT sector of Pakistan.

## **3.2 Population**

Set of interested events, things and people that the researcher wants to study is known as population (Sekaran, 2001). The population for proposed study includes software/IT organization employees from Islamabad, Lahore, Karachi and Rawalpindi. Software sector has been contributing in different parts of Pakistan since a considerable time. Due to large number of population in this sector and different constraints like time limitation and limited resources, it was impossible to cover all the employees working in software department. In Pakistan there are more than 2500 software/IT companies and about 300,000 IT professionals and graduates. Every year this pool is growing (PSEB - Pakistan Software Export Board - Why Pakistan )

### 3.3 Sample and Data Collection

Software sector is an advanced technology sector. Innovative software firms consider innovation and technology as a key tool for competitiveness, therefore, software sector was taken as a sample of this study for data collection. By survey, the empirical analysis of the proposed research framework is carried out. For this survey, about 350 questionnaires were randomly distributed among the employees of software firms. Out of 350 only 310 were answered. The response rate of the survey was 88.57%. But 35 questionnaires were excluded from the evaluation because some of the questions were not filled and it seemed to be incomplete. As a result, a sample of 275 was selected for the study that was the requirement of the study as sample size is calculated using Cochran's formula. It is considered appropriate for such situations in which large population is included. Calculation of sample size is shown below.

$$n_0 = \frac{Z^2 pq}{e^2}$$

As estimated value of Software /IT employees and graduates is more than 300,000 according to PSEB. Most of the respondents of questionnaire include software managers, developers, IT executives and programmers. So let assume that 23% serve as managers, developers, IT executives and programmers in the software sector. That's why value of  $p = 0.23$  as  $p$  is the estimated population that attributed in question. Depending upon the confidence level 95% with 5% plus or minus precision, margin of error  $e$  is taken as  $e = 0.05$ .  $Z = 1.96$  that is selected using confidence interval. By subtracting the  $p$  value from 1,  $q = 0.77$  as the formula is  $q = 1 - p$ .

$$n_0 = \frac{(1.96)(1.96)(0.23)(0.77)}{(0.05)(0.05)}$$

$$n_0 = 272.$$

It was important to select the sampling technique for the collection of data from the selected sample. So, this study was based on **Convenience sampling technique**. It is a non-probability sampling technique in which the data is collected from the respondents that are conveniently available to participate in the study. The

software company employees were contacted with the help of reference person and also by searching more employees on social apps. The respondents were requested to participate in the survey. Questionnaire was sent through online link of survey, emails and hard copies as per convenience.

### 3.3.1 Ethical Consideration

Introductory paragraph in the questionnaire was included for describing the aim and the purpose of the study, providing the surety of keeping the responses and the identity of the participants confidential, survey results will only be analyzed for academic purpose and also if there is any issue regarding the survey then respondents can communicate it to the provided email.

### 3.3.2 Sample Characteristics

Initially for data analysis basic sample characteristics were included. Sample characteristics incorporated in this study are name of the organization, position of the respondent, qualification, experience of the respondent and respondent experience in current organization.

#### 3.3.2.1 Sampling Frequency

The measure of observation of data set and the different categories in data set are presented by **frequency**. Table 3.1 includes frequency that shows the number of people in categories level, **percent** specify the percentage of people in categories level and **cumulative percent** that is calculated by combining the total frequency at or below each categories level.

TABLE 3.1: Frequency Table.

Items	Experiance (Percent)	Experience in Cur- rent orga- nization (Percent)	Qualification (Percent)	Frequency	Cumulative Percent
0-5 years	81.1%			223	81.1%
6-10 years	15.3%			42	96.4%
11-15 years	1.8%			5	98.2%
16-20 years	.7%			2	98.9%
21 and above years	1.1%			3	100.0 %
Total	100.0%			275	
0-5 years		96.7%		266	96.7%
6-10 years		3.3%		9	100.0%
Total		100.0%		275	
Bachelors			78.2%	215	78.2%
MS			18.9%	52	97.1%
MBA			1.5%	4	98.5%
M.Phil			.7%	2	99.3%
B.tech			.4%	1	99.6%
BBA			.4%	1	100.0%
Total			100.0%	275	

In Table 3.1, demographic frequency represents the experience of the respondents that indicate 0-5 years group has the highest value at 81.1% and experience group of 16-20 years and 21 and above years has the lowest value at 0.7%. Sample demographics including the experience of the respondent is shown in Figure 3.1.

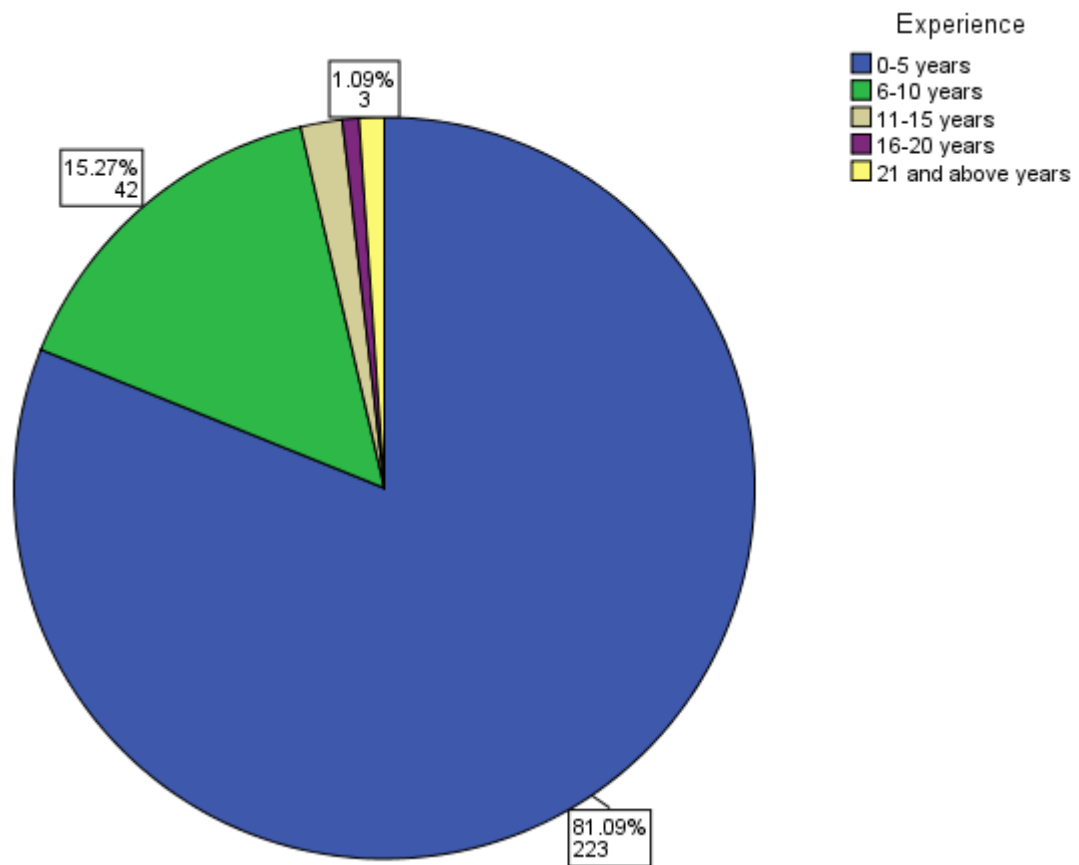


FIGURE 3.1: Experience of Respondents

Furthermore, Table 3.1 shows the experience of the respondents in current organization indicates that 0-5 years group has the highest value at 96.7% and 6-10 years group has the lowest value at 3.3%. Sample demographics including the experience of the respondent in current organization is shown in Figure 3.2.

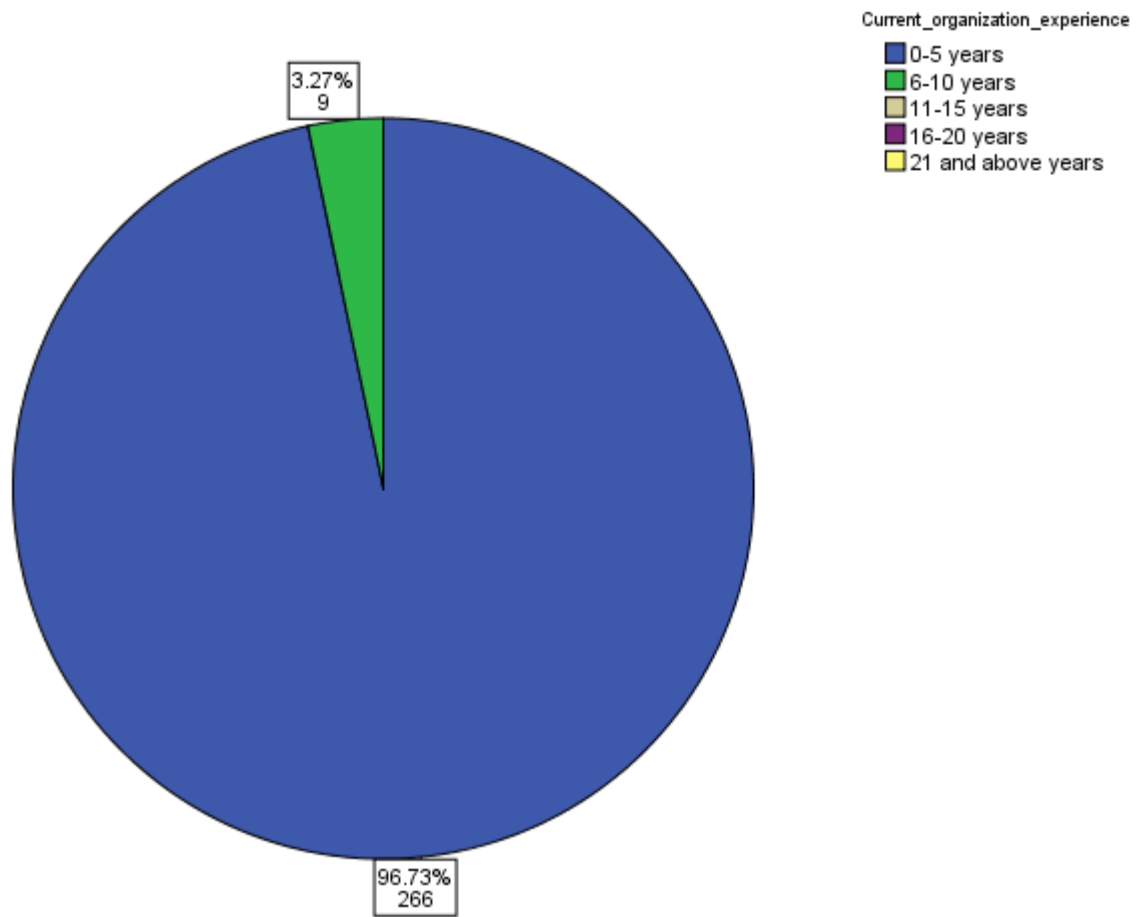


FIGURE 3.2: Experience of Respondents in Current Organization

Moreover, qualification indicates that respondents having bachelors degree have the highest percentage at 78.2% and respondents with degrees of BBA and B.Tech have the lower percentage at 0.4%. Sample demographics including the qualification of the respondents is shown in Figure 3.3.

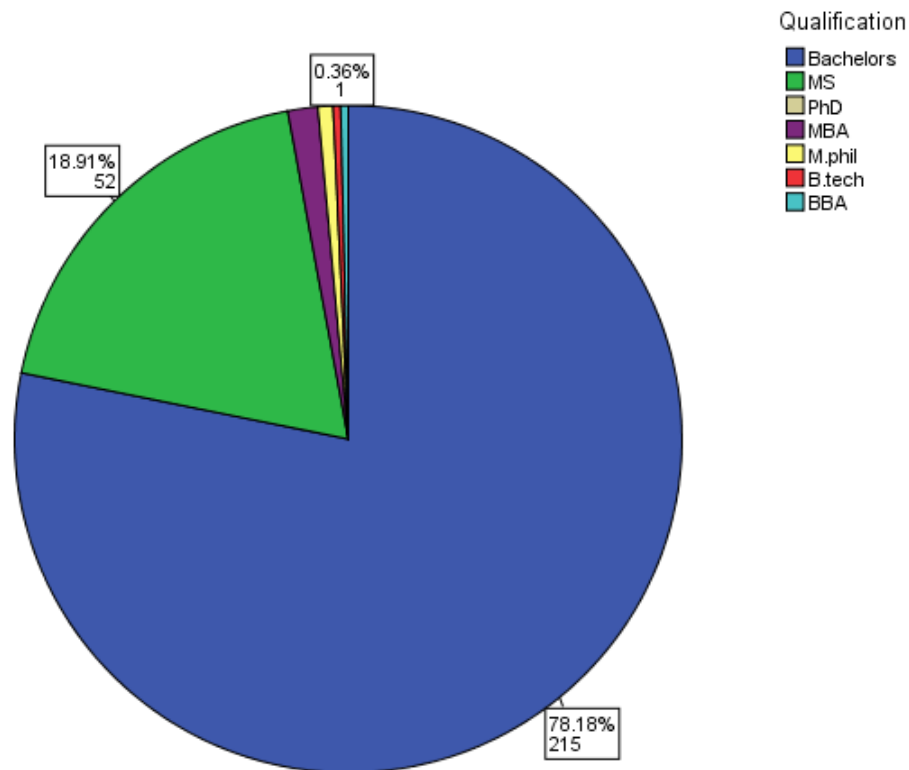


FIGURE 3.3: Qualification of Respondents

### 3.4 Measurement

By utilizing the existing literature, measures used in the questionnaire were adapted. Questionnaire was assembled with the constructs of innovation capability (absorptive capacity, strategic orientation), technological innovation, non-technological innovation and firm learning growth and innovation performance which were filled by software company employees. All the variables were measured on 7-point scale ranging from 1 to 7. Where 1 represents strongly disagree, 2 represents moderately disagree, 3 represents slightly disagree, 4 represents neutral, 5 represents slightly agree, 6 represents moderately agree and 7 represents strongly agree. Respondents rated each of the items on a seven point likert scale. Questionnaire is attached in appendix-A.

### 3.4.1 Innovation Capability

Innovation capability was measured by using two dimensions such as absorptive capacity and strategic orientation.

#### 3.4.1.1 Absorptive Capacity

Absorptive capacity consists of five-question measure. five items related to absorptive capacity was calculated by using the questions developed by Kotabe et al., (2011). The reliability of the variable was **0.76**. Later, Rangus & Slavec (2017) also adapted these questions related to absorptive capacity. Some sample questions were “We have the capability to adapt and acquire new knowledge to meet the firm development need” and “We have the capability to integrate assimilated new knowledge with existing knowledge”.

#### 3.4.1.2 Strategic Orientation

Strategic orientation was measured using two dimensions such as technological orientation and market orientation.

**3.4.1.2.1 Technological Orientation** This variable consists of five-question measure. Items related to technological orientation was measured by using the construct developed and validated by G. Akman & C. Yilmaz (2008). The reliability of the variable was **0.79**. Some sample questions of the variable were “Advanced technologies and methods are used to develop new products in our firm” and “New technologies are integrated to our firm rapidly”.

**3.4.1.2.2 Market Orientation** This variable was measured by the questions of G. Akman & C. Yilmaz (2008). Market orientation consists of twelve-question measure. G. Akman & C. Yilmaz measured the variable of market orientation under three dimensions such as customer orientation, competitor orientation and



interveentional coordination. The reliability of customer orientation was **0.76**; competitor orientation was **0.85** and interveentional coordination was **0.87**. Some sample questions of the variable were “Customer complaints and suggestions are important for our firm”, “our firm acquires knowledge regarding competitors”, “Good integration between departments and functions are provided”.

### **3.4.2 Technological Innovation**

Technological innovation was taken as a mediator in this study. It includes product and process based innovations. Technological innovation consists of six-question measure. The construct was measured by using the questions related to product and process innovation, developed by Ahu Tuba Karabulut (2015). The reliability of product innovation was **0.81** and process innovation was **0.80**. Some sample questions related to technological innovations were “We redesign/customize our products to reach new market niche” and “There are changes in design, features or price of a product to increase sales in our firm.”

### **3.4.3 Non-Technological Innovations**

Non-technological innovation was taken as a mediator in this study. Non-technological innovation consisting organizational innovation was measured using the questions developed by Ahu Tuba Karabulut (2015). Non-technological innovation consists of four-question measure. The reliability of the variable was **0.70**. Some sample questions related to non-technological innovations were “There are intranet and database trainings etc. practices to improve knowledge sharing in our firm, there are changes in design” and “ISO standards are applied in our firm”.

### **3.4.4 Firm Performance**

Firm performance was measured on the basis of innovation performance, learning and growth performance. Firm innovation performance was measured by using the

questions of Faruk Kalay & Gary S. Lynn (2015). The reliability of firm innovation performance was **0.92**. And firm learning and growth performance was measured using the questions developed by Ahu Tuba Karabulut (2015). The reliability of firm learning and growth performance was **0.70**. Firm performance consists of nine-question measure. Some sample questions of the variable were "Employee turnover rate has decreased" and "Our firm is better than our competitors at developing new products to meet customers needs".

### 3.5 Instrument Pilot Test

The reliability analysis of all variables included in the research work was conducted by using Cronbachs Alpha approach to evaluate the internal consistency. 51-100 questionnaires were used for analysis. Main aim for doing pilot study is to examine the relevancy, consistency and reliability of the items selected. Results of reliability that shows the internal consistency of each variable are shown in Table 3.2

TABLE 3.2: Reliability statistics.

S.No	Variables	Sources	Alpha ( $\alpha$ )	Items
1	Innovation Capability	Kotabe, Jiang, and Mur-ray (2011), G. Akman and C.Yilmaz (2008)	.933	22
2	Technological Innovation	AhuTuğba Karabulut (2015)	.824	6
3	Non-Technological Innovation	Ahu Tuğba Karabulut (2015)	.704	2
4	Firm Performance	Faruk Kalay and Gary S. Lynn (2015), Ahu Tuğba Karabulut (2015)	.910	9

All the variables included in the study represent high  $\alpha$  coefficient (i.e  $\geq 0.7$ ) based

on responses collected in 2018 from software company employees'. Cronbach's alpha value indicated good **internal consistency reliability**. The scales which have been adapted from the previous literature are closely linked with the topic and justifying the variables and their strength of measure. Furthermore the reliability statistics have proven the consistency of the each construct showing the high relevancy and relation between scale of variables and validated the measure for this research work as the scale of innovation capability by Kotabe, Jiang, and Murray (2011) and G. Akman and C. Yilmaz (2008), technological innovation and non-technological innovation by Ahu Tuğba Karabulut (2015) and firm performance by Faruk Kalay and Gary S. Lynn (2015) and Ahu Tuğba Karabulut (2015).

### **3.6 Tools for Data Analysis**

IBM SPSS statistics 20 was used for evaluating the data. Majority of the responses belonged to the small and medium sized software firms. Procedural tests that were carried out using SPSS were reliability analysis, regression analysis, factor analysis, mediation analysis, frequency distribution, descriptive statics and correlation analysis.

### **3.7 Exploratory Factor Analysis**

EFA is a statistical method that allows the items to load freely without constraints. Factor analysis was used to enhance the results of analysis in which the cross loaded items were deleted in the pattern matrix such as four items of innovation capability, two items of technological innovation, two items of Non- technological innovation and two items of firm performance. It classifies the number of factors measured by the questionnaire and resolves the construct validity issue.

TABLE 3.3: Factor Analysis of All Items.

Pattern Matrix <sup>a</sup>										
Factors										
	1	2	3	4	5	6	7	8	9	10
IC3	.831									
IC5	.697									
IC6	.665									
IC1	.615									
IC2	.546									
IC11		.818								
IC10		.712								
IC9		.696								
IC12		.621								
IC7		.425								
IC14			.846							
IC13			.556							
IC15			.504							
IC16			.348							
IC18				.753						
IC20				.717						
IC19				.712						
IC24					.909					
IC25					.766					
IC22					.612					
IC26					.546					
IC23					.523					
TI3						.617				
TI2						.569				
TI1						.310				
TI8							.864			
TI7							.513			



# Chapter 4

## Data Analysis and Results

This chapter discusses about different tests conducted on the sample data. Results of tests were analyzed according to which hypothesis are accepted or rejected.

### 4.1 Reliability Analysis of Scales Used

Reliability test is conducted through cronbachs alpha that measures the internal reliability of the items. Range of cronbachs alpha is 0 to 1. Reliability analysis of the scale shows the ability of the scale to give consistent results when retested number of times. Higher the cronbachs alpha, higher will be the reliability of the scale. Considering all the responses, Table 4.1 shown below represents the reliability of the scales used in data collection. Items having the value of 0.8 and 0.9 specify that these scales are highly reliable. According to George and Mallery (2003), value of cronbachs alpha is acceptable at 0.50, however it's good to have more or equal to 0.70.

TABLE 4.1: Reliability statistics.

S.No	Variables	Alpha( $\alpha$ ) Cronbach's	Items
1	Innovation Capability	.906	22
2	Technological Innovation	.757	6

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3	Non-Technological Innovation	.625	2
4	Firm Performance	.886	9

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## 4.2 Descriptive Statistics

Statistics provide techniques for collecting the data and sorting it. Descriptive statistics measures for the statistical units in a specific group and summarize the sample data. This approach of descriptive statistics is described by Franzese & Iuliano (2018) to carry out the accurate statistical investigation. Descriptive statistics regarded to this study is shown in Table 4.2.

TABLE 4.2: Descriptive Statistics.

---

	<b>N</b>	<b>Minimum</b>	<b>Maximum</b>	<b>Mean</b>	<b>Median</b>	<b>Mode</b>	<b>SD</b>
IC	275	4.18	7.00	5.8643	5.9091	6.00	.65104
TI	275	2.67	7.00	5.7042	5.8333	5.67	.86295
NI	275	1.00	7.00	5.1964	5.5000	6.00	1.31895
FP	275	2.33	7.00	5.4137	5.5556	5.56	.96270
Valid	275						
N							
(list-							
wise)							

---

Table 4.2 specifies the descriptive statistics of all variables included in current research work. It provides the understanding of the sample size, mean, standard deviation, maximum and minimum. Mean indicates the average of the sample data. Independent variable such as innovation capability was showing the highest mean of 5.86. Specific value that separates the higher half values of sample data from lower half values is known as median. Median of innovation capability was showing the highest value of 5.90. Value which occurs often in the sample data is known as mode. Mode of IC was 6.00; TI was 5.67; NI was 6.00 and FP was 5.56. Standard deviation demonstrates the dispersion of the sample data relative

to its mean. Standard deviation of IC was .65; TI was .86; NI was 1.31 and FP was .96. Minimum and the maximum values of all the variables were between 1 to 7 as variables were measured by 7-point likert scale.

### 4.3 Correlation Analysis

Correlation analysis is a statistical method. Correlation measures the strength between two quantitative variables and also tells about the direction of relationship whether they are positively or negatively correlated to each other (Franzese & Iuliano, 2018a). Range of coefficient of correlation is -1.00 to +1.00. This statistical method indicates the possible connections between the variables that can be useful for the researcher. Value of -1.00 specifies the strong negative relation and +1.00 indicates the strong positive relation. Various assumptions were considered while performing Pearson correlation analysis that were no outliers, level of measurement, linearity, related pairs and normality of variables. Result of correlation analysis is shown in Table 4.3.

TABLE 4.3: Correlation Analysis.

	<b>IC</b>	<b>TI</b>	<b>NI</b>	<b>FP</b>
Innovation Capability (IC)	1	.62	.43	.59
Technological innovation (TI)		1	.40	.56
Non-Technological innovation (NI)			1	.51
Firm Performance (FP)				1

Table 4.3 of correlation analysis supports the correlation between the variables. It indicates that the variable of IC and TI has a positive correlation with the strong significant value of .62. It specifies if innovation capability enhances then technological innovation also enhances. Moreover, results also specify that the value of correlation between IC and NI was .43. This shows if innovation capability increases then non-technological innovation also increases. Furthermore, results also show that IC is positively related to FP as value of correlation is .59. It



determines that if firm has innovation capability then it improves its performance. Additionally, results claim that the value of correlation between TI and NI is .40. This specifies that technological innovation has a direct relation with non-technological innovation. If one increases then other also increases. Results also prove that TI is positively related to FP with significant value of .56. It represents that if technological innovation rises then firm performance also rises. Results also provide the value of correlation between NI and FP as a positive significant value of .51. It shows that if non technological innovation increases there will be an increase in firm performance.

## 4.4 Regression Analysis

Regression analysis is obtained by investigating that how independent variable relates to the dependent variable. Altman and Krzywinski (2015) mentioned a statistical method for examining the relationship among two variables  $x$  (independent variable) and  $y$  (response variable or dependent variable) termed as regression analysis. Regression analysis shows that by varying the independent variable (innovation capability), dependent variable (firm performance) also changes. Assumption taken under consideration during performing regression analysis was to analyze the outliers because liner regression is sensitive to the effects of outliers. Normality of the data was verified by analyzing the value of kurtosis and skewness. For determining the outliers -1.29 - 1.29 range was considered. Statistic value of all the items of kurtosis and skewness were falling in this range that concluded there is no outlier. Also, multicollinearity was checked. No multicollinearity exists as shown by the results of correlation analysis that the correlation coefficients were smaller than 1, Table 4.4 and Table 4.5 specify the findings

TABLE 4.4: Model Summary.

Model	R	R <sup>2</sup>	Adjusted R <sup>2</sup>	Std. Error of the Estimate
1	.598 <sup>a</sup>	.358	.355	.77306

a. Predictors: (Constant), IC

As shown in Table 4.4 of model summary provides the values of R, R<sup>2</sup> and Adjusted R<sup>2</sup>. Simple correlation is represented by value of R. R<sup>2</sup> represents independent variable causes what change in the dependent variable. Adjusted R<sup>2</sup> is desired property of goodness of fit statement. In this study, R=.589 indicate the high degree of correlation between IC and FP, value of R<sup>2</sup>=.358 specify 35.8% variation can be caused by the independent variable in the dependent variable and value of Adjusted R<sup>2</sup>=.335 shows 35.5% variance can be caused.

TABLE 4.5: Coefficient.

Model	Unstandardized		Standardized	t	Sig.
	Coefficient		Coefficient		
	B	Std. Error	Beta		
(Constant)	.229	.423		.541	.589
IC	.884	.072	.598	12.325	.000

Results in the above Table 4.5 of coefficients provide the important information of predicting firm performance from innovation capability. Value of **Sig** concludes whether innovation capability contributes statistically significant to the model. In this case, value of Sig=.000 indicates IC is statistically and significantly related to FP. Additionally, values of B column under unstandardized coefficients can be used to represent the regression equation that is shown below

$$Y = a + bX$$

$$\text{Firm Performance} = .229 + .884(\text{Innovation Capability})$$

## 4.5 Mediation Analysis and Hypothesis Testing

The mediator variable determines the relationship between dependent and independent variable. In current study two mediators were included such as technological innovation and non technological innovation. Two tools were utilized to test the dual and partial effects of mediators between independent and dependent variable.

### 4.5.1 Testing Dual Mediation Effect

PROCESS v2 16.3 macro tool by Andrew F. Hayes was used for evaluation of dual mediation. As this study includes two mediators therefore, model 6 with two mediators was used according to the model templates for PROCESS for SPSS and SAS provided by Andrew F. Hayes (A. F. Hayes, 2013). Variables included in the model analysis were X=Innovation capability (IC), Y= Firm Performance (FP), M1=Technological Innovation (TI) and M2=Non-Technological innovation (NI). Sample size was 275. Results of model analysis are shown below. Table 4.6 specify the relationship between IC and TI.

TABLE 4.6: Relationship between IC and TI.

	<b>Effect</b>	<b>P</b>	<b>LLCI</b>	<b>ULCI</b>
<b>IC</b>	.8337	.0000	.7109	.9565

a. Outcome:TI

Table 4.6 results represents that IC had an effect of .8337 on TI and value of  $p < 0.05$  showed significant relation exists between IC and TI that also justifies  $H_1$  hypothesis. Impact of IC on TI is shown by Figure 4.1.

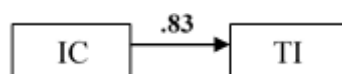


FIGURE 4.1: Effect of IC on TI

Relationship of IC and NI, TI and NI is shown in Table 4.7.

TABLE 4.7: Relationship between IC and NI; TI and NI .

	<b>Effect</b>	<b>P</b>	<b>LLCI</b>	<b>ULCI</b>
<b>TI</b>	.3296	.0019	.1222	.5371
<b>IC</b>	.6080	.0000	.3331	.8830

a. Outcome:NI

Table 4.7 illustrates TI had an effect of .33296 on NI and value of  $p < 0.05$  that specifies significant relation exists between them that validates hypothesis  $H_8$ . Furthermore, it also indicates IC had an effect of .6080 on NI and value of  $p < 0.05$  which shows a significant relation between them and justifies hypothesis  $H_2$ . Effect of TI on NI, IC on NI is shown in Figure 4.2.

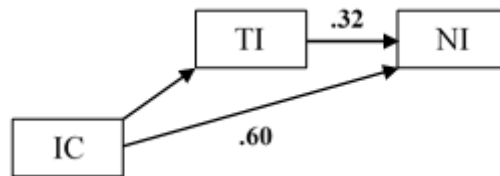


FIGURE 4.2: Effect of TI on NI; IC on NI

Relationship between IC and FP; NI and FP; TI and FP is shown in Table 4.8.

TABLE 4.8: Relationship between IC and NI; TI and NI .

	<b>Effect</b>	<b>P</b>	<b>LLCI</b>	<b>ULCI</b>
<b>TI</b>	.2876	.0000	.1612	.4141
<b>NI</b>	.1985	.0000	.1270	.2700
<b>IC</b>	.4691	.0000	.2988	.6395

a. Outcome:FP

Table 4.8 explains that TI had an effect of .2876 on FP and value of  $p < 0.05$  that identifies significant positive relation exists between them and validates hypothesis  $H_6$ . Additionally, it also indicates NI had an effect of .1985 on FP and value of  $p < 0.05$  which shows a significant relation between them as well and accepts hypothesis  $H_7$ . Results also show that IC had a direct effect of .4691 on FP and value of  $p < 0.05$  that specifies significant positive relation between them as and it validates hypothesis  $H_3$ . Effect of IC on FP; TI on FP; NI on FP is shown in Figure 4.3.

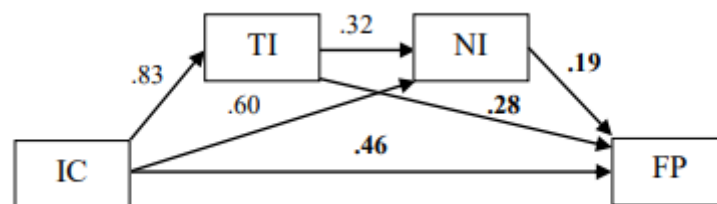


FIGURE 4.3: Effect of IC on FP; TI on FP; NI on FP

Total effect that is based on the sum of direct effect and total indirect effect of IC on FP is shown in Table 4.9

TABLE 4.9: Total Effect of IC on FP.

	<b>Effect</b>	<b>P</b>	<b>LLCI</b>	<b>ULCI</b>
<b>IC</b>	.8842	.0000	.7429	1.0245

a. Outcome:TI

Table 4.9 demonstrates IC had a total effect of .8842 on FP. Also value of  $p < 0.05$  shows significant relation between them as shown in Figure 4.4.

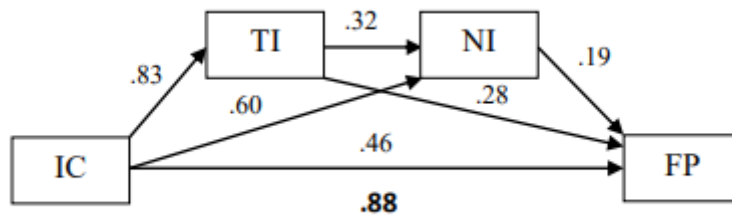


FIGURE 4.4: Total Effect of IC on FP

Table 4.10 shows the indirect effects of independent variable (IC) on dependent variable (FP). Model includes three indirect effects of IC on FP. Indirect effect keys used in the table are shown below

**Ind1:** IC → TI → FP

**Ind2:** IC → TI → NI → FP

**Ind3:** IC → NI → FP

TABLE 4.10: Indirect effects of IC on FP.

	Effect	Boot LLCI	Boot ULCI
Total	.4150	.2932	.5519
Ind1	.2398	.1292	.3584
Ind2	.0545	.0152	.1194
Ind3	.1207	.0553	.2175

Table 4.10 shows that the total indirect effect was .4150 with no zero lying between the lower limit LLCI=.2932 and upper limit ULCI=.5519 that demonstrates a mediating effect. Furthermore, results indicate Ind1 with the mediating effect of TI turned out to be .2398 with no zero lying between the lower limit LLCI=.1292 and upper limit ULCI=.3584. The absence of zero value between lower and upper limits demonstrates that TI acts as a mediator between independent variable (IC) and dependent variable (FP). This validates the hypothesis  $H_4$ . Results also narrate Ind2 with the mediating effects of TI and NI turned out to be .0545 with no zero lying between the lower limit LLCI=.0152 and upper limit ULCI=.1194.

Therefore, results demonstrates the dual effect of mediating variables (TI and NI) that plays the role of mediator between independent variable (IC) and dependent variable (FP). Moreover, results also specify Ind3 with the mediating effect of NI turned out to be .1207 with no zero lying between the lower limit LLCI=.0553 and upper limit ULCI=.2175. So, results specify that NI acts as a mediator between independent variable (IC) and dependent variable (FP). This validates the hypothesis  $H_5$ .

## 4.5.2 Mediation with Bootstrapping

Bootstrapping is a statistical test. To estimate the sampling distribution empirically, it uses variability within a sample instead of making assumptions about the sampling distribution. In this current research work, mediation with bootstrapping is utilized to specify the partial effect of the mediators by using Preacher and Hayes (2008) multiple mediation indirect tool. Two mediators are included in this study such as technological innovation and non-technological innovation. Therefore, two models are tested partially.

**Model1** comprises of the effect of IC on FP through TI.

**Model2** comprises of the effect of IC on FP through NI.

### 4.5.2.1 Model 1

Direct and indirect effects using TI as a mediator between IC and FP are revealed in Table 4.11.

TABLE 4.11: Effects Using TI as a Mediator.

<b>Paths</b>	<b>B</b>	<b>t</b>	<b>P</b>
IC → TI (a path)	.8337	13.3678	.0000
TI → FP(b path)	.3530	5.3192	.0000
IC → FP(c path)	.8842	12.3253	.0000
IC →FP(c' path)	.5898	6.7039	.0000

Table 4.11 narrates that there exist a positive association between IC and TI ( $\beta=.83$ ,  $t(272)=13.36$ ,  $p=.0000$ ). Additionally, TI and FP are positively associated with each other ( $\beta=.30$ ,  $t(272)=5.31$ ,  $p=.0000$ ). Moreover, total effect of IC on FP indicates a positive relation between them ( $\beta=.88$ ,  $t(272)=12.32$ ,  $p=.0000$ ) and direct effect of IC on FP also shows the positive association between them ( $\beta=.58$ ,  $t(272)=6.70$ ,  $p=.0000$ ). Results supported the relationships as indicated by significance level and regression coefficient. Results are also shown by the following Figure 4.5 that also demonstrates that variance exists in direct and indirect effect.

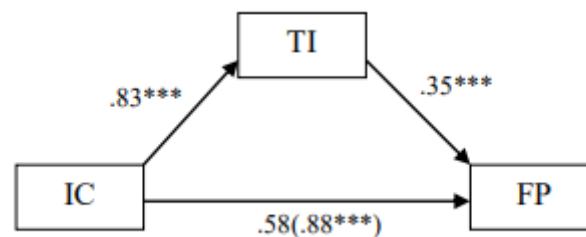


FIGURE 4.5: Effect of IC on FP through TI

Note: \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$

TABLE 4.12: Bootstrap Results of Indirect Effect of TI.

	<b>Data</b>	<b>Upper</b>	<b>Lower</b>
Total	.2943	.1830	.4280
TI	.2943	.1830	.4280

Table 4.12 demonstrates the indirect effect of IC on FP using TI as a mediator. Result indicates that TI plays the role of mediator between IC and FP as no zero value exists between the lower and upper limits. Results of Table 4.11, Table 4.12 and Figure 4.5 validate the hypothesis  $H_4$ .



### 4.5.2.2 Model 2

Direct and indirect effects using NI as a mediator between IC and FP are given in Table 4.13.

TABLE 4.13: Effects Using NI as a Mediator.

Paths	B	t	P
IC → TI (a path)	.8829	8.0027	.0000
TI → FP(b path)	.2288	6.1992	.0000
IC → FP(c path)	.8842	12.3253	.0000
IC →FP(c' path)	.6822	9.1264	.0000

Table 4.13 results identify that there exist a positive association between IC and NI ( $\beta=.88$ ,  $t(272)=8.00$ ,  $p=.0000$ ). Additionally, NI and FP are positively associated with each other ( $\beta=.22$ ,  $t(272)=6.19$ ,  $p=.0000$ ). Moreover, total effect of IC on FP indicates a positive relation between them ( $\beta=.88$ ,  $t(272)=12.32$ ,  $p=.0000$ ) and direct effect of IC on FP also shows the positive association between them ( $\beta=.68$ ,  $t(272)=9.12$ ,  $p=.0000$ ). Results supported the relationships as indicated by significance level and regression coefficient. Results are also shown in Figure 4.6.

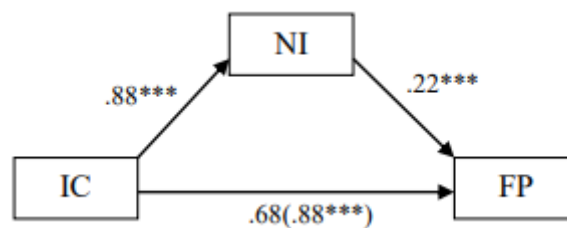


FIGURE 4.6: Effect of IC on FP through NI

Note: \* $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

TABLE 4.14: Bootstrap Results of Indirect Effect of M2.

	Data	Upper	Lower
Total	.2020	.1194	.3232
NI	.2020	.1194	.3232

Table 4.14 describes the indirect effect of IC on FP using NI as a mediator. Result indicates NI plays the role of mediator between IC and FP as no zero value exists between the lower and upper limits. Results of Table 4.13, Table 4.14 and Figure 4.6 validates the hypothesis  $H_5$ .

## 4.6 Results Summary

Hypotheses were accepted or rejected on the basis of the statistical test performed. Results are shown in Table 4.15.

TABLE 4.15: Results Summary.

<b>Hypothesis</b>	<b>Statement</b>	<b>Results</b>
$H_1$	Innovation Capability has a significant positive impact on Technological Innovation	Accepted
$H_2$	Innovation Capability has a significant positive impact on Non-Technological Innovation	Accepted
$H_3$	Innovation Capability has a significant positive impact on Firm Performance	Accepted
$H_4$	Technological Innovation mediates the link between Innovation Capability and Firm Performance	Accepted
$H_5$	Non-Technological Innovation mediated the link between Innovation Capability and Firm Performance	Accepted
$H_6$	Technological Innovation has a significant positive impact on Firm Performance	Accepted
$H_7$	Non-Technological Innovation has a significant positive impact on Firm Performance	Accepted
$H_8$	Technological Innovation has a significant positive impact on non-Technological Innovation	Accepted

# Chapter 5

## Discussion and Conclusion

This chapter is divided into four major parts such as discussion, theoretical and practical implications, conclusion, limitations and future recommendations. **Discussion** section discusses about the hypothesis results, with which the results of current study are consistent or inconsistent. **Conclusion** section concludes the overall study. **Theoretical, practical and empirical implications** section discusses about the contribution of study in literature and engineering management domain. **Limitations and future recommendations** discusses about the limitations of current research work that gives direction for future research work.

### 5.1 Discussion

Main aim of the study was to provide a detailed understanding of how multi-dimensional impact of innovation capability effects the performance (learning, growth and innovation performance) of high technology firms directly and indirectly through technological and non-technological innovations in Pakistan Software/IT related companies. Data findings and theory supported eight hypothesis developed for the current study. Findings on the basis of this study are discussed below. Findings of the proposed study suggested that high technology firms such as software firms with high level of absorptive capacity, technological orientation and

market orientation outperform than firms having other capabilities. This study adopted RBV as a theoretical lens that contributes in achieving the competitive advantage. Findings of the current study confirm the importance of resources such as knowledge and technology that are significant drivers of innovation capability that contributes in improving firm performance.

Results of the analyzed data show that IC has a positive significant impact on TI (product innovation and process innovation) and IC also has a significant positive relation with NI (organizational innovation). It was determined that firms which have innovation capability were more involved in technological and non-technological innovations, which results in a better position in their competitive environment. The result is reliable with the literature signifying that capability development and product innovation are linked to each other (Wang& Chen, 2018). Additionally this result also support the study of Du Preez et al., (2009) that says that capability is important to implement innovation.

Moreover, results of the proposed study specified that IC is positively associated with FP. In other words, result demonstrates innovation capability of a firm determines its performance. This result is significant with the literature supporting that IC and FP are positively related to each other (Rajapathirana & Hui, 2018; Saunila & Pekkola, 2014).

Furthermore, results of the current study identified that TI mediates the relation between IC and FP. It was indicated that firm possessing innovation capability performs technological innovations which in turn impacts the firm performance. In literature, different researchers examined the mediating role of product and process innovations between different variables. Some found a significant positive result of process innovation as a mediator and insignificant result according to product innovation as a mediator (Dahiyat, 2017) while other identified a significant result of product innovation as a mediator (Sharma et al., 2016). This study has taken TI as a mediator has shown a significant result regarding the role of TI as a mediator between IC and FP.

Additionally, results indicated that NI also mediates the relation between IC and FP. It was determined that firm having innovation capability performs non-technological innovation (organizational innovation) which in turn improves the firm performance. Several studies identified that organizational innovation acts as a mediator between different variables (Naghaviet al., 2012; Prange & Carlos, 2017). In current study, NI (organizational innovation) acts as a mediator between IC and FP.

Two methods were used to test the mediation effect of TI and NI. First method concluded the dual or combined effect of mediators between IC and FP that supported the role of TI and NI as mediators. Second method concluded the separate effects of mediators. In both cases there is a slightly small difference between c-path and c'-path coefficient values that indicated the partial mediating role of TI between IC and FP and also partial effect of mediating variable NI between IC and FP.

Results also contributed in determining the significant positive relation between TI and FP that showed firm that execute technological innovations (product innovation, process innovation) ultimately enhance their firm performance. Result of the current study is consistent with the previous studies showing significant positive relation of product innovation with firm performance (Espallardo & Ballester, 2009; Varis & Littunen, 2010) and process innovation with firm performance (Ar & Baki, 2011; Varis, M. & Littunen, 2010). Findings are also consistent with the previous study of Atalay et al., (2013) showing significant relation between TI and FP.

Findings revealed that NI has a significant positive relation with FP. Firm having the capability to introduce non-technological innovation eventually improve their firm performance. Finding is significant with the supporting literature that identified positive relation between NI (organizational innovation) and FP (Chang & Lee, 2008). But the findings are not consistent with the study of Atalay, Anafarta,

& Sarvan(2013) showing insignificant relation between NI and FP. Findings suggested that positive relation exists between technological innovation and non technological innovation. Technological innovations (process innovation and product innovation) drive non-technological innovation (organizational innovation). Implementation of both types of innovations is necessary in order to improve firm performance. Results are consistent with the past study that concludes interaction between TI and NI improves FP (Ryu HS., 2015).

## **5.2 Theoretical and Practical Implications**

Current study has contributed in the literature as Rajapathirana & Hui (2017) directed to explore the multidimensional effect of innovation capability. No study outlined the multi-dimensional effect of innovation capability on firm performance in Pakistani context. Proposed study has many contributions to the engineering management domain of innovations. Engineering management is the mixture of engineering and business practices that are concerned with the design, development, improvement and implementation of systems, processes and models by considering engineering relationships with management tasks such as plan, organize, control, direct and lead the human element in production, marketing, research and other services.

At first, innovation capability is considered as a multi-dimensional model. Dimension include absorptive capacity, technological orientation and market orientation that are the essential elements which make a firm capable for doing innovations and enhance its performance. Knowledge is the main resource of absorptive capacity and market orientation. Technology and knowledge about technology both serve as resources that make a firm capable to improve its performance. RBV theory also demonstrated that resources are the key components that makes difference between the performances of firms.

Second, two types of innovations such as TI and NI are focused as mediators between IC and FP. TI and NI both are necessary to be implemented as TI is

based on the engineering practices and NI is based on the business practices. So its a perfect combo for engineering management domain of innovations. Results of the mediation test also specify that if TI and NI both are tested together as a dual mediation then variation between the direct effect and indirect effect is greater than the variation that occurs when they are implemented partially. TI and NI also increase the firm performance. The relation of TI and NI as mediators between IC and FP was missing in the literature. The finding of the study confirmed the relationship in the contextual setting of Pakistan.

Current study demonstrates that IC enhances FP, therefore study suggests that technology based firms having IC based on their absorptive capacity, technological orientation and market orientation. This forms the basis of doing TI and NI that consequently enables a firm to maintain its position in the competitive environment.

### **5.3 Limitations and Future Consideration**

Despite of this fact that current research has achieved some important conclusions and insight, results and the finding of the study should be considered with some limitations that provide researchers with new ideas and suggestions and this practice gives rise to the future research work.

First limitation is that the current study was carried out on the software sector of Pakistan. The sample used in the study was taken from both small and large software firms of Pakistan. Therefore, the results are limited to this sample only. Same study can be conducted in other sectors of developing countries where such studies are rare. In future, other technology companies or sectors like manufacturing sector can be considered as there is a possibility that may be different results are acquired.

Second, proposed study is based on single sector, data can also be acquired from multiple sectors to improve the validity of findings instead of this fact that several empirical studies were based on single sector.

Third, control variable such as gender of the respondent was not considered. This may have affected the results as sample data can be male-biased or female-biased. Future studies can examine the effect of control variables on the outcome.

Fourth, the results and significance of the study will be helpful for the future researchers focusing on this area to link innovation capability with other variables for better firm performance. This study only includes two mediators and doesn't include any moderating effect. So, similar studies are needed to examine the effect of IC on FP by considering different constructs as moderators like performance measurement or model can be improved by adding other mediators or moderators as well.

Fifth, time restriction was the main limitation of current study. So, longitudinal study can be conducted to investigate the effect of IC on FP where data will be collected with specific time intervals. This may affect the findings of the study because it is a cross-sectional study where data is collected once within 2 months. The study is expected to make contributions to the firms in the field of innovation.

Sixth, only three dimensions of innovation capability were included in this study. Further, innovation capability with other dimensions of personnel capability, operational capability and structural capability should be studied to explore the influence of multi-dimensional variable such as IC on FP.

## **5.4 Conclusion**

Main objective of the study was to find out the effect of IC on FP with the mediating role of TI and NI. Sample data was collected from software firms of Pakistan through a survey based methodology to measure the extent to which



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IC impacts FP with mediating role of TI and NI. The sample data was based on 275 questionnaires that were analyzed. Statistical tests specify the reliability and validity of the variables included in the research model. RBV theory was utilized that supported the proposed hypotheses. Findings of the study are also in line with RBV theory that illustrates firm performance. According to which resources contribute in achieving the competitive advantage. Resources can be new knowledge or information, technology and individuals that make a firm capable of improving its performance and stand out differently from others. All the proposed hypotheses are accepted in the context of Pakistan.

# Chapter 6

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# Appendices

# Appendix-A

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Dear Respondent, I am a student of Capital University of Science and Technology and I am conducting this survey for my Master thesis. The under designed study will attempt to determine the impact of innovation capabilities on firm performance. This questionnaire is designed only for research purpose that targets software sector.

There are no right and wrong answers as long as you did it honestly. Your answers will be helpful in meeting the needs of the survey. Rest assured that your answers to this survey-questionnaire will be treated with utmost confidentiality. The survey results will only be analyzed for academic purposes.

Thank you for your time and kind cooperation in the conduct of this study. Your valuable response will contribute to this academic research. In case you have any question regarding this survey. Any concern can be communicated to mehreenarif222@gmail.com.

Mehreen Arif  
(Researcher)

**SECTION A:**Background Information

Name of Company: \_\_\_\_\_

Position of Respondent:\_\_\_\_\_

Year of Experience :\_\_\_\_\_

**SECTION B:** Using the scale below please answer each of the following question carefully for accurate evaluation with your experience in each of the following area. Please tick one option that best represents your opinion.(1=Strongly disagree, 2=Moderately disagree, 3=Slightly disagree, 4=Neutral, 5=Slightly agree, 6=Moderately agree, 7=Strongly Agree)

INNOVATION CAPABILITY								
	Absorptive Capacity	1	2	3	4	5	6	7
AC1	We have the capability to adapt and acquire new knowledge to meet the firm development needs							
AC2	We have the capability to develop new applications by applying assimilated new knowledge							
AC3	We have the capability to find alternative uses of assimilated new knowledge							
AC4	We have the capability to introduce product/service innovation based on acquired new knowledge							
AC5	We have the capability to integrate assimilated new knowledge with existing knowledge							
AC6	We have the capability to re-engineer processes based on acquired new knowledge							

<b>Technological Orientation</b>								
TO1	R&D activities are very important for our firm							
TO2	New product ideas are perceived to be a source of competitive advantage to our firm							
TO3	Advanced technologies and methods are used to develop new products in our firm							
TO4	New product development process is directed by technical personnel							
TO5	New technologies are integrated to our firm rapidly							
TO6	Our firm is initiator of development of new technologies and products							



<b>Market Orientation</b>								
MO1	Customer complaints and suggestions are important for our firm							
MO2	After-sales service is important for our firm							
MO3	We are committed to our customers							
MO4	Customers needs play a vital role in our cost-benefit analysis, as we believe in life time value of our customers							
MO5	Our firm follows competitors marketing efforts							
MO6	Our firm acquires knowledge regarding competitors							
MO7	Our firm gives rapid and efficient response to competitors actions							
MO8	Our firm evaluates competitors actions and strategies by means of senior managers							
MO9	Our firm seeks continual opportunities that provide competitive advantage							
MO10	When plans and strategies are prepared all departments act together							
MO11	Customer knowledge is shared with all related departments							
MO12	There is continual communication between department and functions of our firm							

MO13	Good integration between departments and functions are provided							
MO14	Knowledge exchange about each topics between departments are performed in systematic meetings							
<b>TECHNOLOGICAL INNOVATION</b>								
TI1	We develop new products which can be used for different purposes							
TI2	We have at least one product which is our own intellectual property.							
TI3	We redesign/customize our products to reach new market richness.							
TI4	Advanced technology is used to develop our products							
TI5	There are changes in production methods in our firm compared to earlier years							
TI6	We can finish production earlier by the help of computer aided softwares which are used in our firm							
TI7	Costs are controlled during the production process in our firm and savings are achieved by getting rid of unnecessary ones							
TI8	We keep record of lead time of our products							

<b>NON-TECHNOLOGICAL INNOVATION</b>								
NI1	There are intranet, database training etc. practices to improve knowledge sharing in our firm							
NI2	Outsourcing (purchasing, recruiting, technological support, consulting etc.) which has not been used before is used recently in our firm							
NI3	Cooperation among functions provide time and cost benefits in our firm							
NI4	ISO standards are applied in our firm							
<b>FIRM PERFORMANCE</b>								
<b>Learning and Growth Performance</b>								
FP1	Employee are happy and satisfied with the job							
FP2	Employee turnover rate has decreased							
FP3	Number of employee suggestions has increased							
FP4	Number of implemented employee suggestions has increased							
FP5	We are gathering information about new products							
FP6	We are gathering information about new customers							

<b>Innovation Performance</b>								
FP7	Our firm is better than our competitors at developing new products to meet customers needs							
FP8	Our firm is perceived by our customers to be more innovative than our competitors.							
FP9	Our firm is more effective than our competitors at capturing ideas and convert them into new products							
FP10	Our firm is better in terms of the number of innovations (new products) than our competitors over the last 2 years							
FP11	The duration it takes between the conception of an innovation and its introduction into the market place by our firm is better than the industry average							