INNOVATION APPROACHES, PRACTICES AND FIRM PERFORMANCE AMONG SELECT SOFTWARE PRODUCT SMEs: A CASE OF BANGALORE FIRMS

THESIS

Submitted in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

By

SUMUKH S HUNGUND

(Reg.No.135001HM13F03)

SCHOOL OF MANAGEMENT

NATIONAL INSTITUTE OF TECHNOLOGY KARNATAKA,

SURATHKAL, MANGALORE – 575025

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D E C L A R A T I O N

I hereby declare that the Research Thesis entitled "INNOVATION APPROACHES, PRACTICES AND FIRM PERFORMANCE AMONG SELECT SOFTWARE PRODUCT SMEs: A CASE OF BANGALORE FIRMS" Which is being submitted to the National Institute of Technology Karnataka, Surathkal in partial fulfilment of the requirements for the award of the degree of Doctor of Philosophy in Management is a bonafide report of the research work carried out by me. The material contained in this Research Thesis has not been submitted to any University or Institution for the award of any degree.

Sumukh S Hungund
(135001HM13F03)

School of Management
Place: NITK-Surathkal
Date:

C E R T I F I C A T E

This is to certify that the Research Thesis entitled "INNOVATION APPROACHES, PRACTICES AND FIRM PERFORMANCE AMONG SELECT SOFTWARE PRODUCT SMEs: A CASE OF BANGALORE FIRMS" submitted by SUMUKH S HUNGUND, (Register Number: 135001HM13F03) as the record of the research work carried out by him, is accepted as the Research Thesis submission in partial fulfilment of the requirements for the award of degree of Doctor of Philosophy.

Prof. K B KIRAN
Research Guide
and
Chairman, DRPC

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ABSTRACT

Innovation is considered as a topic of interest among both academicians and practitioners. Right from Schumpeter till current day researchers have worked extensively in the area of innovation, yet the topic appears to be fresh and new. Henry Chesbrough coined the terms ‘open innovation’ and ‘closed innovation’ in his pioneering work. Small and Medium Enterprises are a major part of an economy and essential for its growth. In India, SMEs play a very important role in generating employment and growth of the economy. At present, Indian SMEs adopt innovation for sustaining their growth rather than radical transformation. A rigorous review of literature points to research gaps to study the innovation approach adoption and its influence on firm performance among SMEs.

The present work adopts a case-study approach to study the SMEs of Bangalore region. A structured online survey was administered to 213 survey participants identified through criterion based snowball sampling method. Firm-level factors such as age, size, experience, and culture have been perceived to have a significant influence to adopt innovation approach. However, investment in Research and Development does not influence SMEs to adopt Innovation. As for External factors, ecosystem and competition have a significant influence on the adoption of innovation approach. Other factors such as technological advancement, government policy, and customer have a relatively lesser role in the adoption of innovation approach. Further, open innovation practices such as collaboration, Spin-offs, and alliances positively influence firm performance. IPR trading is still not encouraged in the Indian context. Closed Innovation approach also influences the firm performance. Hence, the decision makers of SMEs should cautiously reflect on the innovation approach suitable to their firm at that point in time. Adoption of innovation approach should be considered by the SMEs as a strategic choice for their growth and sustainability.

Key Words: Open Innovation, Closed Innovation, Firm Performance, Firm level Factors and External factors.

Abbreviations

CIP: Closed Innovation Practices

FICCI: Federation of Indian Chambers of Commerce & Industry

FP: Firm Performance

iSPIRIT: Indian Software Product Industry Round Table

IPR : Intellectual Property Rights

MPD: More Product Development

MS: Market Share

MSME: Micro Small and Medium Enterprises

NASSCOM: National Association of Software and Services Companies

OIP: Open Innovation Practices

PS: Product Sales

SME: Small and Medium Enterprises

Chapter 1
Introduction

1.1 Introduction

The term Innovation is widely accepted by industry and academic professionals as an essential competitive enabler for any enterprise to sustain growth (Drucker, 1985). Innovation is viewed as the main driver for companies to prosper, grow and sustain high profits (Drucker, 1988). Innovation has long been considered as a prominent growth engine to brace competitiveness of the firm in the market. Both large and small and medium firms use innovation practices to sustain a competitive advantage (Yifeng, 2011; Mashilo and Iyamu, 2012). Innovation is claimed to be the driver of success but is said to be difficult for small firms to implement innovation practices (Iakovleva, 2013). Innovation is also termed as the successful process of implementing creative ideas (Ford, 1996). The Organization for Economic Cooperation and Development (OECD) found that innovation is the primary factor that determines a country's long-term economic growth and increase in productivity and that innovation is even more important to an economy than either capital or labor resources alone (OECD, 2008). National Knowledge Commission report (2007) reveals that innovation has the most significant impact on competitiveness for large firms while for SME's, innovation will make an indelible impact on the increase in market share. The innovation process is undergoing profound changes in the way it is managed (Chesbrough, 2003). Innovation Management also faces new paradigms such as globalization and technological intensity (Chesbrough, 2003; Chesbrough, 2004; Chesbrough and Schwartz, 2007). Innovation approach can be categorized as closed innovation and open innovation. Closed innovation approach is said to be a process where firms develop products and services by using only their internal in-house resources and technologies and then commercialize those innovations on their own (Chesbrough, 2003). Open innovation, which was named and defined by Chesbrough as the "purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively". Open innovation is a

process which systematically encourages and explores a wide range of internal and external sources for innovation opportunities, consciously integrating the firm capabilities and resources, and broadly exploiting those opportunities through multiple channels (Cohen and Levinthal, 1990). Open innovation is becoming one of the hottest topics in innovation management (Wang and Tang, 2013). The open innovation approach has been flaunted by the area of innovation management and technology (Mazini et al., 2013). Open innovation practices are useful in reducing costs of Research and Development(R & D) and create new avenues for growth. Open innovation leads to business growth (Huang et al. 2010). Open innovation models emphasize using a broad range of knowledge sources for a firm's innovation and invention activities by including customers, competitors, and academicians to exploit the firm's IP (West and Gallagher, 2006). Open innovation boosts the probability that firms will achieve business growth by evolving new products (Freel 2006). Open innovation emphasizes that the collaboration with partners happens primarily to build new internal (technological) competencies (Vanhaverbeke, 2013). Firms practice two types of open innovation approach i.e. inbound open innovation and outbound open innovation (Chesbrough and Crowther, 2006). An inbound open innovation approach is where the ideas and knowledge flow from outside the organization into the organization whereas outbound open innovation refers to sharing of ideas and knowledge to the outside world. A general barrier to open innovation in an SME is said to be the perception that open innovation will be too time-consuming to get access to a knowledge base of external partner (Iakovleva, 2013). Open innovation adoption is influenced by (i) firm's market position (ii) product placement in the product life cycle curve and (iii) potential scale of opportunities (Christensen et al. 2005). Figure 1.1 is a reproduction of Chesbrough (2003) visual depiction of the closed innovation and open innovation.

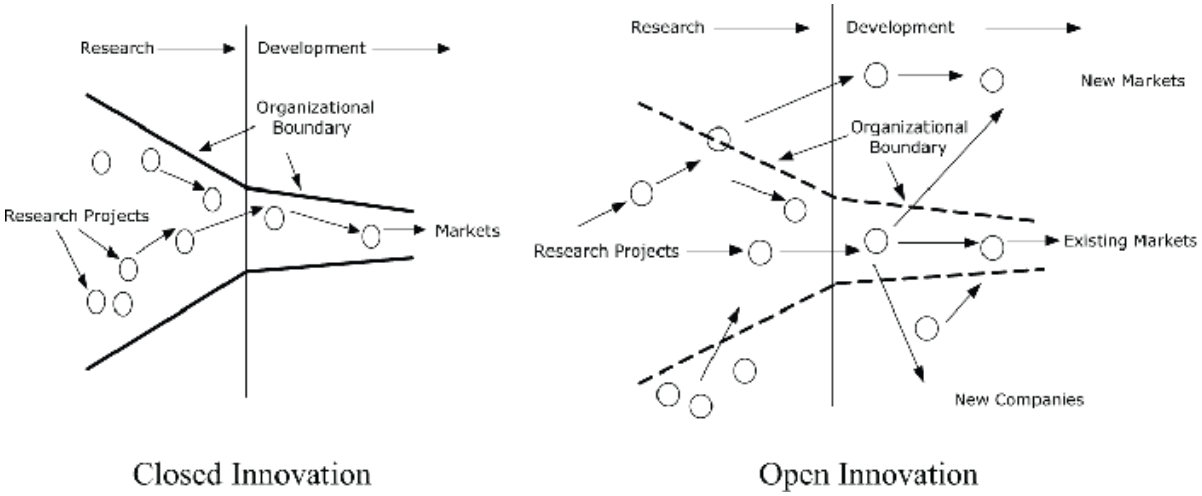

Fig 1.1 Innovation Approaches. (Source: Chesbrough, 2003)

1.2 Importance of Micro Small and Medium Enterprises in an Economy

Micro-Small- and Medium Enterprises (MSMEs) occupy an important and strategic place in economic growth and equitable development in all countries. Promotion of MSMEs is considered as one of the major strategies by the government as it provides major employment opportunities. In general, more jobs per unit of capital investment are produced by MSMEs as compared to a large enterprise. Moreover, it can be started with fairly less capital, further enables fostering of entrepreneurship. Apart from that, MSMEs have more flexibility in production and have the potential for developing managerial skills, individual initiatives, and rich personal relations. Therefore, it is often promoted as a source of technological innovations among developed economies (Bala Subrahmanya, 2005b). SMEs are responsible for the growth of the majority of industrial units and also contribute to the substantial proportion of employment, output, and exports in most developing and developed economies. Some of the common features of SMEs are greater operational flexibility, individual initiative, and skills, low cost of production, high propensity to adopt the technology, the high capability to innovate, high employment orientation, etc. (Tujeta, 2002). In developing countries, SMEs are responsible for most employment and income generation opportunities and can be identified as the main driver

for poverty alleviation. The flexibility and specialization of SMEs can also contribute, in some cases, to the adaptability and diversification of national production systems (UNCTAD, 2005).

In most national economies, SMEs account for a majority of business establishments (Chew and Yeung, 2001). SMEs usually comprise 95 percent of all enterprises and account for from 44 to 70 percent of employment and 50 percent of manufacturing output in developed countries. The figures for developing countries, although suspect reveals the same situation: SMEs appear to account for about 95 percent of enterprises, 50 to 80 percent of industrial employment, and 50 percent of manufacturing output (UNCTAD, 2005). In general, the role of SMEs in the economic, industrial and social activities has become more important than before in every country.

1.2.1 MSME in India

Small enterprises are defined based on a number of criteria such as (1) employment, (2) turnover, (3) assets, (4) managerial processes, and (5) other criteria (sometimes based on ownership or independence) (Atkins and Lowe, 1996). The definition of a small enterprise varies enormously between industry sectors and between countries (Nanjundan, 1994). The most commonly used criteria for defining an MSME are the number of people employed and/or financial criteria – either the turnover or income or the assets of the business.

The micro, small and medium enterprises (MSME) sector contribute significantly to the manufacturing output, employment, and exports of the country. MSME sector accounts for about 45 percent of the manufacturing output and around 40 percent of the total export of India. The MSME sector is estimated to employ about 101.26 million persons in over 44.77 million units throughout the country. The MSME contributes about 8 percent of the GDP of the country. Further, this sector has consistently registered a higher growth rate compared to the rest of the industrial sector. There are over 6000 products ranging from basic commodities to highly specialized products /services, which are being

manufactured by the MSMEs in India (MSME report 2015-16). Indian MSMEs have moved up from the manufacture of traditional goods including leather, gems and jewelry, agricultural goods to much more value addition in the manufacturing sector to its entry in the value-added services as well (FICCI-MSME Report, 2012).

The term MSME defines small-scale industrial units and medium-scale industrial units. MSMEs can be defined in terms of firm size and firm ownership. Firm size can be defined in terms of land, labour (employees), and capital (Investment made). Firm ownership refers to a type of ownership and nature of the organization. MSMEs are defined in different ways in different countries and at different times. The overall objective of defining SMEs is to segregate them from the rest of industry for extending policy support for exclusive promotion.

1.2.2 Definition of MSME

In India, MSME is defined as per MSME Act of 2006. According to the Act, a micro firm is a firm which has an investment in plant & machinery up to 25 lakhs INR in manufacturing and up to 10 lakhs INR in service, a small firm is a firm which has an investment in plant & machinery between 25 lakhs to 5 crore INR in manufacturing and between 10 lakhs INR to 2 crore INR in service, a medium firm is a firm plant & machinery between 5 crores to 10 crore INR in manufacturing and between 2 crore and 5 crore INR in service.

According to OECD (2005), Small and Medium-sized Enterprises are non-subsidiary, independent firms which employ a fewer number of employees. This number varies across countries. The most frequent maximum limit designating an SME is 250 employees, and further, the classification is a micro firm with less than 10 employees, small firms are between 11-50 employees, and medium firms are between 51-250 employees.

The following table provides the information about MSMEs classification across Asia-Pacific region and the European Union

Table 1.1 SMEs according to Asia-Pacific region

Country Name	Definition
Cambodia	Firms that employ between 11 and 50 employees and have fixed assets of $50,000 to $250,000 are categorized as small. Firms with 51200 employees and fixed assets of $250,000 to $500,000 are medium sized.
Indonesia	Fewer than 100 employees
Lao People's Democratic Republic	"Small enterprises are those having an annual average number of employees not exceeding 19 persons or total assets not exceeding two hundred and fifty million kip or an annual turnover not exceeding four hundred million kip". "Medium-sized enterprises are those having an annual average number of employees not exceeding 99 persons or total assets not exceeding one billion two hundred million kip or an annual turnover not exceeding 1 billion kip".
Malaysia	Depends on the business sector. Different criteria, based on the number of employees and annual sales turnover.
Philippines	Fewer than 200 employees and less than P 40 million in assets.
Thailand	Depends on the business sector. Different criteria based on a number of employees and fixed capital size.
Viet Nam	SMEs are independent production and business establishments that are duly registered according to the current law provisions, each with registered capital not exceeding VND 10 billion or annual labour not exceeding 300 people.

Sources:

- Cambodia, SME Development Framework of 2005 (Ministry of Industry, Mines, and Energy).

- Lao People's Democratic Republic, Decree 42/PM on the Promotion and Development of Small and Medium-Sized Enterprises (Vientiane, 2004), art.2
- Malaysia, Definitions for Small and Medium Enterprises in Malaysia (Secretariat to National SME Development Council and Bank Negara Malaysia, 2005), available at www.smeinfo.com.my/pdf/ sme_definitions_ENGLISH.pdf.
- Viet Nam, Decree on Support for Development of Small- and Medium-sized Enterprises (Hanoi, Ministry of Planning and Investment, 2001), chap. 1, art. 3
- http://cms.sme.go.th/ cms/web/homing

Table 1.2 SMEs according to the European Union

Enterprise category	Head Count	Turn Over in Euros	Balance Sheet Total in Euros
Medium-sized	< 250	≤ 50 million	≤ 43 million
Small	< 50	≤ 10 million	≤ 10 million
Micro	< 10	≤ 2 million	≤ 2 million

Source: European Commission Recommendation 2003/361/EC of 6 May 2003 concerning the definition of micro, small and medium-sized enterprises

Available at http://ec.europa.eu/enterprise/ enterprise policy/sme_definition/index_en.htm.

1.3 Innovation

Joseph Schumpeter is said to be the first economist to state the importance of innovation. In his famous book "The Theory of Economic Development," he asserts that innovation represents the driving force of economic development. The key process in the economic force of changes is the introduction of innovation and culture of innovation in the enterprise (Schumpeter, 1934). Innovation is one of the main factors underlying countries' international competitiveness and their productivity, output, and employment performance. The production and use of knowledge are at the core of value-added activities and innovation is at the core of firm's and nation's strategies for growth (Michie, 1998).

Edwards and Delbridge (2001) define an innovative firm as one that identifies, interprets and applies knowledge effectively and as appropriate throughout the organization. Innovation can be defined as the application of new ideas to products, processes or any other aspect of a firm's activities. Roy and Wield (1985) view technological innovation as a process of transforming an idea into a saleable product or service. Innovation is said to occur when a new idea is successfully commercialized. Rogers (1998) feels that innovation is an approach to commercialization of an idea. A technological product innovation can involve either a new or an improved version of the previous product and a technological process innovation is the adoption of new or significantly improved production methods, including methods of product delivery (OECD, 1997). Innovation is viewed as the creation, development, and introduction of new product/services, or product/service components, or a new procedure or process for doing things to benefit one or more of the stakeholders in an organization (Birchall et al., 1996). Sen and Egelhoff (2000) argue for the need of "incremental innovation" i.e. innovation capabilities of a firm focused on improving existing products and processes, and "radical innovation" i.e. developing new products and processes based on entirely different concepts and theories. Wang and Ahmed (2004) define "organizational innovativeness as an organization's overall innovative capability of introducing new products to the market, or opening up new markets, through combining strategic orientation with innovative behavior and process." Hence, Innovation can also be defined as a process of problem-solving of customer's unheard need that can also benefit the society at large.

1.3.1 Innovation in MSME

The innovation report of FICCI on MSME gives a great insight into how the different industrial sectors in MSME have come up with the adoption of innovation. Fig 1.2 gives the percentage share of innovation adoption and innovative products. The high technology industries such as Information Technology (IT), Electronic products and the like have adopted innovation to a large extent as compared to traditional industrial segments like Gems & Jewellary, Textiles and the like. The IT segment has the highest

share. Around 57% of the companies in IT product category have adopted innovation practices and deliver innovative products.

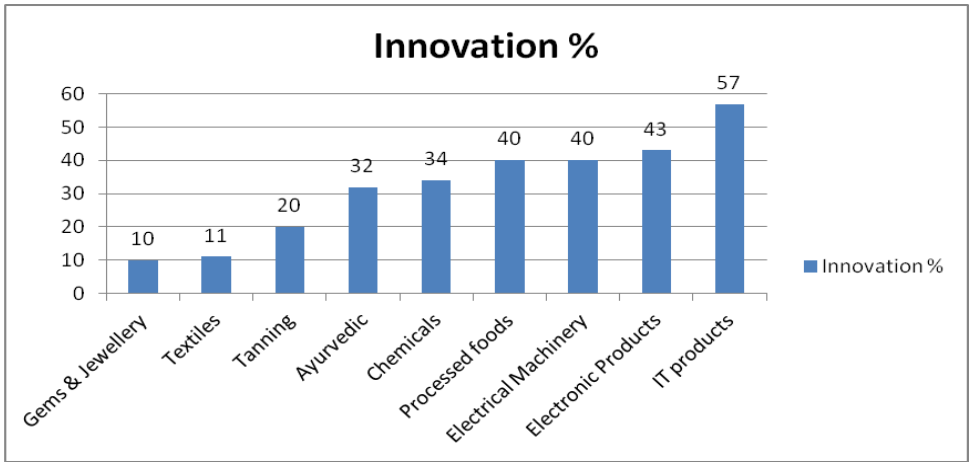

Fig 1.2 Share of innovating companies (Source: FICCI MSME Summit Report, 2012)

1.4 Software Product Industry in India

The software product industry has seen a considerable growth in the last from a little over 100 firms in the year 2000 to nearly 2400 in the year 2013. As per NASSCOM, the revenue from the software product segment is expected to reach 10 billion USD by 2020. India's software product industry think-tank, in their first 'Product Industry Monitor report (PIM),' analyzes India's software product industry landscape. The think-tank estimates that the Indian software product industry has the potential to grow USD 100 billion by 2025. The think tank feels that the domestic market for software products is expected to grow by almost three times the global growth rate. A good part of this increased demand for software products will come from the SME sector and socially significant sectors such as healthcare and education (iSPIRIT 2014). Computer Software / Services production is estimated at US$ 103 billion accounts for a share of 5.48 percent in India's GDP at current prices during the year 2013-14(ESC India report, 2015).

The fig.1.3 represents the number of new software product companies venturing every year. It could be noticed that at least 100 new companies are starting every year since 2010.

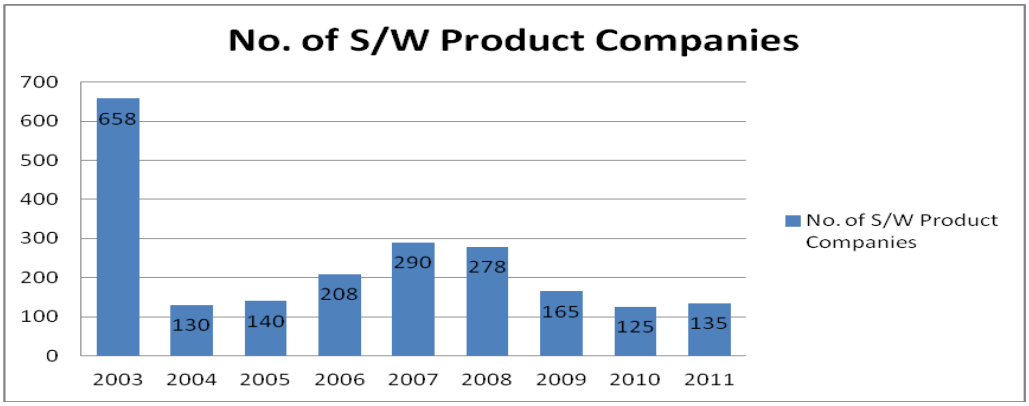

Fig:1.3 No. of new Software Product firms Year wise (Source: NASSCOM)

1.5 Statement of Problem

Any firm grows with the experiences within & outside the environment. The large firms have their own R&D division, and also a recent trend is seen in these firms of making their firm boundary permeable and adopting innovation as their strategy to be market leader, Whereas small and medium firms are seen to depend on R&D of large firms, and yet the competitiveness of the SMEs make a mark on the contribution to the GDP.

Given the present scenario, it is of critical interest to assess what drives Technological SMEs take on innovation in open & closed formats. The current practices of innovation approach need to be enumerated by studying the characteristics of firms & the dynamics that govern it. The present study is an attempt to evaluate forms & formats of Innovation practices and its influence on the performance of the firm.

1.6 Conceptual Framework of the Study

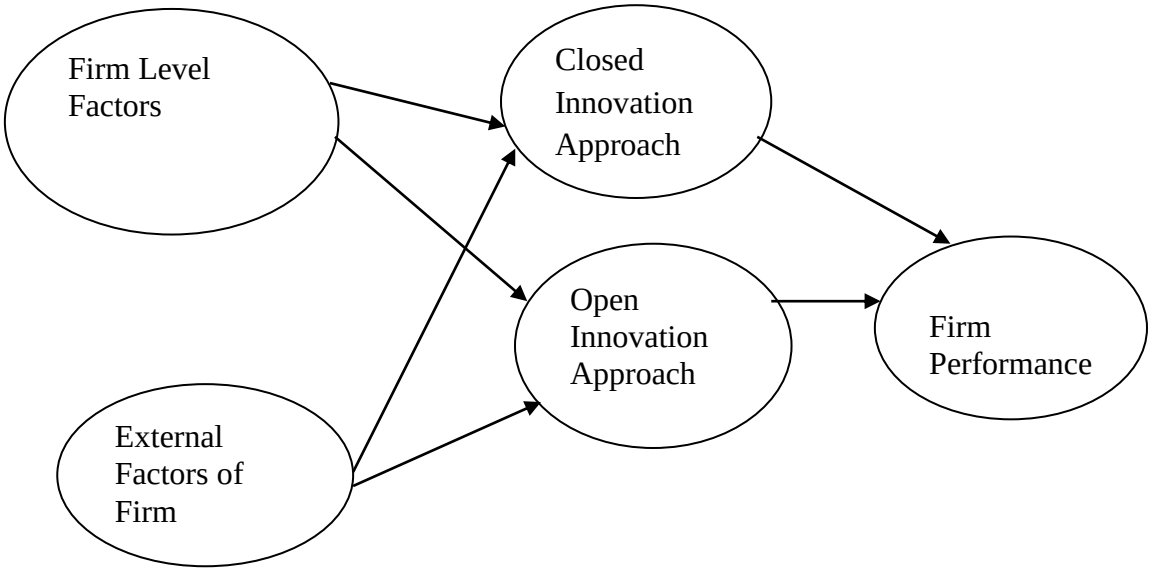

Fig 1.4 Conceptual Framework

SME's Firm performance is dependent on innovation practices adopted and practiced by these firms. The firm's strategic choice of innovation practices are of two types i.e. Open Innovation and Closed Innovation. The Open Innovation practices include Collaborations with external agents like Academic Institutions, Suppliers, Customers and R&D Labs, Spin-offs of products from parent organization, Intellectual Property Rights trading and Strategic Alliances. Closed Innovation practices include internal Research & Development. The adoption of open innovation or closed innovation is influenced by firm-level factors or external factors or both. The firm-level factors include that influences adoption are Size of the firm, Age of the firm, Education level of Manager/Entrepreneur, Work experience of Manager/Entrepreneur, Research & Development and firm culture. The external level factors that influence innovation adoption are Competition, Technological Advances, Customers, Ecosystem and Government Policies.

1.7 Research Questions

The research questions for the study are:

1. What are key motives and challenges for SMEs to adopt Innovation?
2. Is there an association between awareness of Innovation approach and its adoption?
3. Does a firm internal factors and external factor influence to practice Open/Closed innovation approach?
4. Given the nature of Open/Closed Innovation approach adopted, How does it influence firm performance?

1.8 Research Objectives

The research objectives of the study are:

1. To search for the motives and challenges for SMEs to practice Innovation;
2. To find out the level of association between awareness and level of adoption of innovation approaches among Indian SMEs;
3. To evaluate whether the internal and external characteristics of firm influences to practices approaches of Open Innovation or Closed Innovation or both;
4. To examine the influence of Open Innovation practices on firm's performance
5. To examine the influence of Closed Innovation practices on firm's performance &
6. To determine policy implications for the promotion of Open/Closed Innovation in the SME sector.

1.9 Statement of Hypotheses

SMEs have an awareness of open innovation practices and closed innovation practices. Also, these SMEs have adopted these two types of practices of innovation. In order to test the association between awareness of innovation approach and its adoption, following hypotheses are stated.

H_{01}: There is no significant positive association between awareness and adoption among Innovation approaches.

$H_{A1:}$ There is a significant positive association between awareness and adoption among Innovation approaches.

Adoption of Innovation among SMEs is influenced by firm-level factors or external factors or both firm level and external factors to the firm. Hence in order to test the influence of these factors on the adoption of innovation approach among SMEs, following hypotheses are stated:

H_{02a}: There is no significant influence of internal factors of the firm to adopt Innovation approach

H_{A2a}: There is significant influence of internal factors of the firm to adopt Innovation approach

H_{02b}: There is no significant influence of external factors of the firm to adopt Innovation approach

H_{A2b}: There is significant influence of external factors of the firm to adopt Innovation approach

H_{02c}: The internal level factors and external level factors together do not significantly influence to adopt innovation approach.

H_{A2c}: The internal level factors and external level factors together do significantly influence to adopt innovation approach

Innovation approach practiced influences firm performance of SMEs. Hence to test the influence of SMEs adoption of open innovation approach on its firm performance, following hypotheses are stated.

H_{03a1}: Practices of Open Innovation approaches do not significantly improve performance of the firm

H_{A3a1}: Practices of Open Innovation approaches do significantly improve performance of the firm

H_{03a2}: Practices of Open Innovation approaches do not significantly influence the firm's market share

H_{A3a2}: Practices of Open Innovation approaches do significantly influence the firm's market share

H_{03a3}: Practices of Open Innovation approaches do not significantly influence the firm's Revenue

H_{A3a3}: Practices of Open Innovation approaches do significantly influence the firm's Revenue

H_{03a4}: Practices of Open Innovation approaches do not significantly influence the firm's Product Sales

H_{A3a4}: Practices of Open Innovation approaches do significantly influence the firm's Product Sales

H_{03a5}: Practices of Open Innovation approaches do not significantly influence firms to develop more products

H_{A3a5}: Practices of Open Innovation approaches do significantly influence firms to develop more products

Innovation approach practiced influences firm performance of SMEs. Hence to test the influence of SMEs adoption of closed innovation approach on its firm performance, following hypotheses are stated.

H_{04a1}: Practices of Closed Innovation approaches do not significantly improve performance of the firm

H_{A4a1}: Practices of Closed Innovation approaches do significantly improve performance of the firm

H_{04a2}: Practices of Closed Innovation approaches do not significantly influence the firm's market share

H_{A4a2}: Practices of Closed Innovation approaches do significantly influence the firm's market share

H_{04a3}: Practices of Closed Innovation approaches do not significantly influence the firm's Revenue

H_{A4a3}: Practices of Closed Innovation approaches do significantly influence the firm's Revenue

H_{04a4}: Practices of Closed Innovation approaches do not significantly influence the firm's Product Sales

H_{A4a4}: Practices of Closed Innovation approaches do significantly influence the firm's Product Sales

H_{04a5}: Practices of Closed Innovation approaches do not significantly influence the firms to develop more products

H_{A4a5}: Practices of Closed Innovation approaches do significantly influence the firm to develop more products

1.10 Scope of the Study

The study would encompass the awareness and adoption of closed and open innovation practices. Also, the study would identify the motivation and challenges of adoption of

innovation practices. Further, the study would investigate the factors that influence to adopt open innovation or closed innovation. Finally, the study would examine the influence of these open innovation and closed innovation practices on performance of the firm. The study is limited to the software product segment of Small and Medium firms located in Bangalore only.

1.11 Organization of Thesis

The thesis is structured into eight chapters. Chapter 1 explicates background information, context, and relevance, research problem, objectives, and hypothesis. Chapter 2 reviews the literature on factors influencing innovation, innovation approach adoption, innovation and firm performance and motivation and challenges to adopting an innovation. Chapter 3 explains the statement of the problem, research questions, research objectives and hypothesis development. Chapter 4 explains research methodologies and study settings. Chapter 5 describes the Profiles of SMEs, awareness, and adoption of innovation (Objective 1 and 2). Chapter 6 investigates the factors influencing adoption of open innovation and closed innovation (Objective 3). Chapter 7 examines the influence of open innovation and closed innovation on firm performance (Objective 4 and 5). Chapter 8 discuss the thesis findings and Chapter 9 provides the conclusion of the study with limitation, also provides policy implications (objective 6) and future work to be carried out.

Chapter 2

Literature Review

2.1 Introduction

This chapter explains the concepts used in the study and reviews the relevant literature with a view to identifying research gap and derive conceptual framework and design research methodology.

2.2 Factors influencing Innovation

The factors influencing firms to adopt innovation can be classified as internal factors and external factors.

2.2.1 Internal factors to firm

A review of past literature reveals that the following internal factors influence the adoption of open approach or closed approach to innovation viz.,

- Firm Size
- Age of the firm
- Research and Development activities in the firm
- Culture of the firm

2.2.1.1 Size

There has been mixed response to the influence of size on a firm's innovation approach. Lichtenthaler (2008) reveals that a firm's size influences positively to adopt open innovation approach. Sondergaard and Burcharth (2011) opine that size of firm influences to the adoption of Open Innovation practices. Abulrub and Lee (2012) examined South Korean firms and found that firm size has a positive influence to adopt an open innovation approach. Mina et al. (2013) opine that firm size influences positively to practice open innovation. Further adds that as size increases the performance of innovation is better. Rangus and Drnovsek (2013) accept that size of the firm influences

the firm to adopt innovation practices. Janerio et al.(2013) prove that firm size influences the adoption of open innovation practices. But the study consists of firms of all size. Ren et al (2015) conclude that firm size have a positive effect on innovation. Van de Vrande et al. (2009) feels smaller the size of the firm is better for the adoption of innovation. Inauen and Schenkc-Wicki (2012) opine that size of the firm impacts firm performance and adoption of innovation practices among technological firms.

Pilav-Velic and Marjanovic (2016) opine that size of the firm is not an important factor for adoption of innovation . Gumus and Cubukcu (2011) found that among Turkish firms, firm size does not influence to adopt open innovation approach. Mazzola et al. (2012) opine that size of the firm negatively influence innovation.

Though we have studies that point to the positive, negative and no influence of a firm's size on the innovation approach adopted by it, a majority of the literature seems to point out that the type of innovation approach adopted by a firm is influenced by its size.

2.2.1.2 Age

Sondergaard and Burcharth (2011) opine that age of the firm does not influence to adopt open innovation. Gumus and Cubukcu (2011) found that the awareness of Open Innovation is little among the Turkish firms. Also, claim that age of the firm does not influence the firm's adoption of Open Innovation practices. Mazzola et al. (2012) opine that age of the firm has a negative influence on adoption of innovation and performance. Mina et al. (2013) opine that age of the firm does influence to practice Open Innovation.

2.2.1.3 Research and Development (R&D)

There has been overwhelming literature that points that the Research Development Activity of a firm has considerable influence on the innovation approach adopted. Roper (1997) finds that an organized R&D activity of small firms influences the firms to practice innovation. Spithoven et al. (2011) show evidence that firms which have R&D emphasis have adopted practices of open innovation. Rayyes and Valls-Pasola (2013) opine that R&D practices have a positive influence on the low and medium technological

firms of the Catalonian region to adopt and practice open innovation practices. Ren et al (2015) conclude that R&D capability has a positive effect on adoption of innovation. Inauen and Schenkc-Wicki (2012) opine that R&D investment impacts firm performance and adoption of innovation practices. Bianchi et al. (2016) suggests that R&D activities of the firms influence the firms in the adoption of Open Innovation practices. Mazzola et al.(2012) argue that R& D expenditure positively influence the innovation performance which in turn influence the firm to adopt an innovation.

Xie (2011) documents that R&D activities among SMEs help in reducing transaction costs and increase the value creation of industry chain, thus indirectly promoting the adoption of open innovation. Pilav-Velic and Marjanovic (2016) present that intensive R & D activities help in adoption of innovation and further education of work force in case of the large organization. Mina et al. (2013) argue that expenditure and investment in R &D improve innovation activity.

2.2.1.4 Culture

Roper (1997) examines small firms across Germany, UK, and Ireland and concludes that innovation adoption is influenced by the cultural and operating environment of the firm. Xu and Zheng (2012) recommend that there is a need to study factors influencing open innovation. Lichtenthaler (2008) opines that there is a need to study on how firm culture influences adoption of open innovation practices in small firms. Gumus and Cubukcu (2011) opine that firm culture towards innovation is essential for adoption of innovation. Krapez, Skerlavaj, and Groznik (2012) enumerate that factors such as culture are essential for adoption of open innovation. Burcharth et al (2013) reveal that firm's culture plays an important role in the adoption of Open Innovation practices. The firm's culture which is measured in terms of attitude and beliefs of employees has a negative influence on adoption of Open Innovation.

Stucki (2009) finds that a firm's internal factors influence and impact the firm's adoption of innovation and on innovation performance respectively.

The above review on internal factors of the firm influencing the adoption on innovation reveals that there is no concurrence among the researchers about the influence of factors such as Age, Size, Culture, and R&D influencing the adoption of open approach or closed approach. Also, the previous researchers have not considered the factors such as education of SME owner and their experience for the adoption of innovation approach.

2.2.2 External factors to firm

Besides the above internal factors, the innovation approach adopted by a firm is considerably influenced by the external factors in which it operates.

Nicita et al. (2005) record the influence of a firm's competitor's in the adoption and practice of innovation and further feel that Innovation in the firm is generally dependent on industrial ecosystem and governance of the firm. Hakkim and Heidrick (2008) opine that government policies will play an eminent role in promoting innovation. Krapez, Skerlavaj, and Groznik (2012) examined Slovenian firms on the support of the government in the adoption of open innovation. They claim that government policies influence the firm to adopt open innovation approaches. Abulrub and Lee (2012) feel that government policies play an important role in the promotion of Open Innovation among SMEs. Rangus and Drnovsek (2013) present that there is a need to study the influence of government policies that stimulate open innovation in the organization. Masson (2013) provide insight that local ecosystem plays an important role in the adoption of innovation approach to problem-solving. De Massis et al. (2011) feel that technological fusion and advancement influences firms to adopt an innovation. Tian and Feng (2010) examined the types of external technology sources in open innovation. They revealed that apart from competitors, the external technology sources for innovation are suppliers, users, universities and research institutes, R&D service companies.

The review of literature pertaining to the externals factors influencing adoption of certain innovation approach reveals that not many studies carried out in this regard. The studies record the influence of external factors like the competitors, industrial ecosystem,

Government policies and its support, technological fusion and advancement in technology play a considerable influence on a firm's adoption of innovation approach. Hence studying the influence of external factors influencing innovation approach becomes essential.

2.3 Motivation and Challenges to adopt Innovation Practices

Chesbrough and Crowther (2006) opine that firms are motivated to adopt Open Innovation practices primarily for new product development activity for market capitalization. They further find that there are two challenges for the firm's to adopt open innovation viz., the resistance of the employees and non-involvement in R & D activities. Hakkim and Heidrik (2008) feel that the main motivation for the firms to adopt an open innovation is to meet the customer demands. Van de Vrande et al. (2009) opines that SME's motivation to embrace open innovation practices is primarily to exploit the market-related activities and to satisfy the customer and they face challenges with regards to adoption of open innovation in terms of cultural issues.

Rodriguez and Lorenzo (2011) find that challenges to adopting open innovation by SMEs is organizational centric namely co-operation and co-ordination. On similar lines, the study by Rayyes and Valls-Pasola (2013) reveal that co-operation is a major challenge to adopt open innovation practices. They further conclude that open innovation opens up new avenues for SMEs but do not confirm that Open Innovation approach is better than Closed Innovation approach. Sondergaard, Knudsen, and Burcharth (2011) discuss challenges faced by firms to adopt Open Innovation and feels that employee resistance is the biggest challenge.

Ades et al (2013) analyze three cases where firms whose innovation management processes have been fused. The study reveals that the cultural issues of the firm are the major challenges for adoption of Open Innovation practices. Birkle and Gewald (2013) opine that the desire to be the market leader motivates the SMEs to go for adoption of

open innovation and they further add that the culture of a firm is the biggest barrier to adopt innovation approaches

2.4 Innovation Approach and Practices

Roper (1997) deducts that small business firms across Germany, UK, and Ireland adopt collaboration and networking with R&D institutes for product innovation. Chesbrough and Crowther (2006) discuss the concept of Open Innovation and its adoption among American in high technology large companies. The study also opines that firms adopt Open Innovation practices primarily for new product development and feels that all outbound Open Innovation practices are not adopted by the firms. West and Gallagher (2006) opine that compared to large firms only a few SME firms have adopted innovation practices such as collaborations, spin-offs and trading of Intellectual Property for their inbound and outbound open innovation activities in software segment. Nicita et al. (2005) try to find out a relationship between Intellectual Property Rights and Innovation They also find that firm's IPRs do not play any role in innovation activities of the firm.

Lichtenthaler (2008) reveals that even though the adoption of closed innovation approach is seen among firms while a trend toward open innovation is also observed. Hakkim and Heidrick (2008) discuss the different approaches to innovation such as Open Innovation and Closed Innovation. They find that firms collaborate with industrial partners such as suppliers, customer and also with academic institutions such as universities for their Research and Development. Also, firms involve in licensing of their Intellectual Property for technology transfer. Van de Vrande et al. (2009) found out that Dutch SMEs have adopted the open innovation practices. The study opinioned that medium-size firms are more active in engaging open innovation practices as compared to smaller size firms. Crampes and Langinier (2009) suggest that Intellectual Property Rights needs to be aligned for Innovation activity. Jayawardhana and Surangi (2010) studied open innovation practices among small and medium ventures in Central Province of Sri Lanka. The study reveals that there is a positive trend towards adoption of open innovation practices and also find that there is a significant difference in the adoption of open

innovation practices within medium and small ventures. Xin and Wang (2011) discuss that SMEs need open innovation for sustaining rather than for converting into large organization. And also that practices of innovation should be carefully adopted by SMEs. And the SME's sustainable development rely on adoption of innovation practices. Spithoven et al. (2011) discussed on the role of intermediaries i.e. collective research centers in building the absorptive capacity of the firm and find that traditional firms which have less absorptive capacity i.e. firms having less R&D expenditure have more inclination towards practices of open innovation.

Schroll and Mild (2011) examined Europeans companies irrespective of size about adoption of open innovation approaches. They found that companies adopt both the open innovation approaches i.e. inbound and outbound and also that the adoption of inbound approach is more prevalent than outbound approaches. They also argue that open innovation approaches strengthen the internal R&D activities or compliment the closed innovation approach. Abulrub and Lee (2012) in their study conclude that South Korean firms which focus on global markets were inclined to adopt Open Innovation practices and further emphasize that collaboration with external partners is beneficial to the firm who are global. Lukac et al (2012) investigated the adoption of Open Innovation model in Information and Communication Technology (ICT) industry in Germany and revealed that the success of innovation requires an unbroken and sustainable flow of innovation to be competitive. Further they opine that collaborative approaches make innovation adoption successful. Kafouros and Forsan (2012) discuss the role of open innovation in emerging economies more specific to India. The study examined firm's openness to adopt external knowledge for Research and Development activities. Xu and Zheng (2012) review extensively the literature of open innovation practices and recommend that there is a need to study how different modes of open innovation complement or substitute each other. Akdogan and Cingoz (2012) investigated SMEs in Turkey and found that collaboration with competitors and customers is practiced.

Cauchick et al. (2013) conducted a pilot case study on open innovation in Brazilian firm. The study concluded that there were multiple ways of collaborations such as cooperation, co-creation, co-design, services, consulting, financing, and others. The study does not discuss actors involved in the collaboration. Janeiro et al. (2013) find that firms which collaborate with academic institutions for innovation activities are more likely to be successful. Rangus and Drnovsek (2013) investigated the practices of Open Innovation in Slovenia and find that firms collaborate with customers and suppliers. The study opines that smaller companies are more inclined to selling/licensing of their IP and further reveal that service firms practice open innovation compared to manufacturing firms. The study does not include all dimension of open innovation mainly the involvement of academic institutes and university.

Segers (2013) observed that there is a strong collaboration between research institutions, universities, venture capitalists, high-risk finance providers, existing large companies, and new biotechnology firms in Belgium. The study feels that basic innovative activity occurs mainly in university-based new biotechnology firms (i.e., new, small firms that are spin-offs from university research centers performing state-of-the-art research

Revutska (2013) finds that the makeover of companies in the open innovation business model is from the viewpoint of strategic development. Further opines that university education centers play a vital role in the process of open innovation models creation and these centers are involved in the formation and commercialization of knowledge and innovation. Mina et al. (2013) studied the open innovation practices among business services firms of UK and Irish Region. The study opinions that firms in knowledge-intensive and high technology oriented industry are open to engaging in Open Innovation practices. The study infers that high tech manufacturing firms engage in collaboration with other Research and Development centers and universities and younger firms engage in informal Open Innovation practices. Birkle and Gewald (2013) examined the status of adoption of open innovation among German SMEs. They found that open innovation

practices have gained importance and can be adopted by SMEs. Venturini et al. (2013) conclude that firms in SME segment of the Republic of San Marino region prefers to collaborate with suppliers and customers for innovation process.

Deegahawature (2014) investigated the extent of implementation of inbound open innovation strategy by Low and Medium-low Technology (LMT) firms in technologically less advanced countries and suggests that LMT firms that adopt inbound open innovation should be cautious on environment turbulence. This study does not discuss about technology exploration through external agents like academia. Almirall et al. (2014) mentions that open innovation practices are practiced to solve civic problems in United States of America. The study reveals that practices such as collaborations help in solving complex problems and concludes that firms need to emulate such practices. Pilav-Velic and Marjanovic (2016) study firms of transition economy and find that firms adopt collaboration as an open innovation approach and also emphasis on R&D activities with external agents. Huizingh (2010) reviews extensively on Open Innovation practices and feels that even though more academic work on Open Innovation is published from past decade yet the concepts are not fully clear among the practitioners and academicians. Hence it becomes essential to know more about Open Innovation practices under different contextual settings.

Marque (2014) discusses about open innovation practices and closed innovation practices and feels that open innovation concept is new and still lacks clarity. Further, firms adopt both open innovation and closed innovation depending on firm strategy. Tsai and Liao (2014) feel that innovation practices such as collaboration with customers help the firm to come out with more successful products. Hidalgo and D'Alvano (2014) discuss about the innovation activities across the service sectors like Healthcare, Education and Retail. The study finds out that collaboration activities is an important innovation practice. Collaborations with academic institutes such as Universities and with Suppliers are being adopted by the service firms for innovation activity for inbound and outbound activities.

2.5 Innovation and Firm Performance

Roper (1997) feels that innovation practices and firm's growth are related. Further studying small firms across Germany, UK and Ireland feels that product innovation leads to firm growth. Chesbrough and Crowther (2006) opine that open innovation is a tool that helps the firms to achieve growth and improve the performance. Huang et al. (2010) opine that open innovation is useful in reducing research and development cost and creates new growth opportunities and leads to firm's growth.

Kafouros and Forsan (2012) discuss influence of Intellectual Property licensing practices on firm performance and conclude the need to study the relationship between these two variables. Bala Subrahmanya (2012) researched on external support and innovation performance of SMEs and concluded that the SMEs' internal technical competence and their nature of innovation help them to fetch external support. Thus SMEs technical competency clubbed with external support exploit market opportunities to achieve higher innovative performance. Mazzola et al. (2012) discuss the influence of Open Innovation practices on firm's innovation performance and financial performance. They further opine that alliances have a negative impact on firm performance and inbound practices such collaboration with academic institutes and suppliers have no influence on firm performance but they do not discuss Intellectual Property Trading which is one of the key Open Innovation practice. Sidik (2012) identifies non-financial measures such as market share as a key indicator of firm performance. Inauen and Schenkc-Wicki (2012) examine the influence of outbound open innovation practices on firm's innovation performance. Further, the study reveals that outbound open innovation practices are more likely to sell more products and also firm's which pursue closed innovation is more likely to exhibit incremental innovation for product development. Akdogan and Cingoz (2012) investigated SMEs in Turkey and found that collaboration with competitors and customers is practiced and has resulted in the positive performance of the firm.

Hung and Chou (2013) detail Open Innovation practices in terms of External Technology Acquisition i.e. Inbound Open Innovation and External Technology Exploitation i.e. Outbound Open Innovation and its influence on firm performance among Taiwanese manufacturing high- tech firms. The study finds that External Technology Acquisition practice positively influences firm performance whereas External Technology Exploitation does not significantly influence firm performance. Rayyes and Valls-Pasola (2013) reveal that open innovation approach adopted by low and medium technological Catalonian firms has a positive impact on its market position. Santos et al. (2014) discuss relationships between innovation efforts and firm performance in Brazil. The study reveals that the hypothesized relationship between innovation variable and performance variables were not identified. The study does neither confirm nor negate that innovation drives superior firm performance.

Ozer and Tınaztepe (2014) discussed effect of leadership styles on performance on the firm. The study was aimed to find out the impact of leadership styles on firm performance. The study identifies the criteria to assess the performance of the firm. The criteria's identified are: (a) Qualified labor (b) Commitment of employees (c) Job satisfaction of employees (d) New product/service development capability (e) Product/service quality (f) Customer satisfaction (g) Sales growth (h) Market share growth (i) Return on sales (k) Return on assets (l) Overall profitability. The study does not discuss innovative approaches of leadership style to determine firm performance.

Sikimic et al. (2016) discuss in licensing practices adopted by Spanish firms. They feel that in licensing practices has a positive influence on the technological outflows and on technological out-licensing. This indicates a positive firm performance on markets seen by adopting this practice of open innovation. Bianchi et al. (2016) opineee that among Spanish manufacturing firms, the external consultants, when engaged with internal R & D team, helps in improving the innovation performance by enhancing the incremental benefits of the technological acquisition.

2.6 Research Gap

From the empirical studies of Lichtenthaler (2008), Van de Vrande et al. (2009), Tian and Feng(2010), Gumus and Cubukcu (2011), Abulrub and Lee (2012) it is clear that studies have only concentrated on adoption of open innovation and have not discussed much on adoption of closed innovation approach.. However, there are limited studies which compare both open innovation practices and closed innovation practices. Also with respect to factors influencing adoption of innovation approach, the internal factors identified are firm age, firm size, investment in R &D and R &D importance and firm culture. Earlier studies have not focused much on entrepreneurs' experience and education. Lukac et al. (2012) suggest that cultural issues in the adoption of innovation practices need to be analyzed. Studies which take into account the influence of firm culture on practices of Innovation are also scarce. Also, studies considering the influence of external factors on innovation are also very few.

Vanhaverbeke, Vermeersch and De Zutter (2012) opines that adoption of open innovation practices in SMEs is quite a different from large organizations and hence there is need to study the practices of open innovation as adopted among SMEs.

Very few studies discuss innovation practices and firm performance (Mazzola, et al. (2012), Cozzarin, (2004), Santos et al. (2014)) but these studies are in the context of European and American firms and discuss only open innovation practices adopted and its influence on firm performance. Also, there is little or no systematic evidence on the type of innovation approach adopted and its influence on firm performance (Sisodiya et al, 2013). Rodriguez and Lorenzo (2011) do not confirm whether Open Innovation approach is better than Closed Innovation approach for SMEs. Hence there is a definitive need to study both innovation approaches, practices and their influence on firm performance.

2.7 Summary

A literature review was done to focus on the factors influencing firms to adopt an innovation, practices of innovation adopted by firms and the influence of these practices on performance. The study so far conducted, identified internal factors and external factors that influence firms to adopt an innovation. The internal factors identified are firm age, firm size, investment in R &D , R &D importance and firm culture. Earlier studies have not focused much on entrepreneurs' experience and education. Also among the external factors influencing adoption of innovation studies are scarce. Also, the review focuses on the practices of open innovation and closed innovation adopted by the firms.

Studies on SME domain on the practices of both open and closed innovation are found to be less. There is limited empirical evidence found on adoption of open innovation practices and its influence on performance. Studies on practices of both open and closed innovation adopted by SMEs and their influence on firm performance are scarce. This is considered an important research gap which needs to be looked at, particularly in the context of a technological SMEs in emerging economy like India.

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Chapter 3

Research Problem and Hypothesis Development

3.1 Introduction

This chapter discusses the statement of the problem, the conceptual framework of the study, Research Questions, Research Objectives and Hypothesis of the study.

3.2 Statement of Problem

Any firm grows with the experiences within & outside the environment. The large firms have their own R&D division and also a recent trend is seen in these firms of making their firm boundary permeable and adopting innovation as their strategy to be a market leader. Whereas small and medium firms are seen to depend on R&D of large firms, and yet the competitiveness of the SMEs make a mark on the contribution to the GDP.

Given the present scenario, it is of critical interest to assess what drives Technological SMEs take on innovation in open & closed formats. The current practices of innovation approach need to be enumerated by studying the characteristics of firms & the dynamics that govern it. The present study is an attempt to evaluate forms & formats of Innovation practices and its influence on the performance of the firm.

3.3 Conceptual Framework of Study

The conceptual framework is based on the theories proposed by Chesbrough(2003) and Vanhaverbeke(2012). Chesbrough(2003) describes the approaches adopted by firms and mentions that there are two approaches that a firm can follow to adopt an innovation. These approaches are termed as an open approach and closed approach. Further Vanhaverbeke(2012) advocates that adoption of open innovation approach helps the firm to improve performance. The study conceptual framework is derived from these two theories. In the current study framework, SME's Firm performance is dependent on innovation practices adopted and practiced by these firms. The firm's strategic choice of innovation practices are of two types i.e. Open Innovation and Closed Innovation. The

Open Innovation practices include Collaborations with external agents like Academic Institutions, Suppliers, Customers and R&D Labs, Spin-offs of products from parent organization, Intellectual Property Rights trading and Strategic Alliances. Closed Innovation practices include internal Research & Development. The adoption of open innovation or closed innovation is influenced by firm-level factors or external factors or both. The firm-level factors include that influences adoption are Size of the firm, Age of the firm, Education level of Manager/Entrepreneur, Work experience of Manager/Entrepreneur, Research & Development and firm culture. The external level factors that influence innovation adoption are Competition, Technological Advances, Customers, Ecosystem and Government Policies.

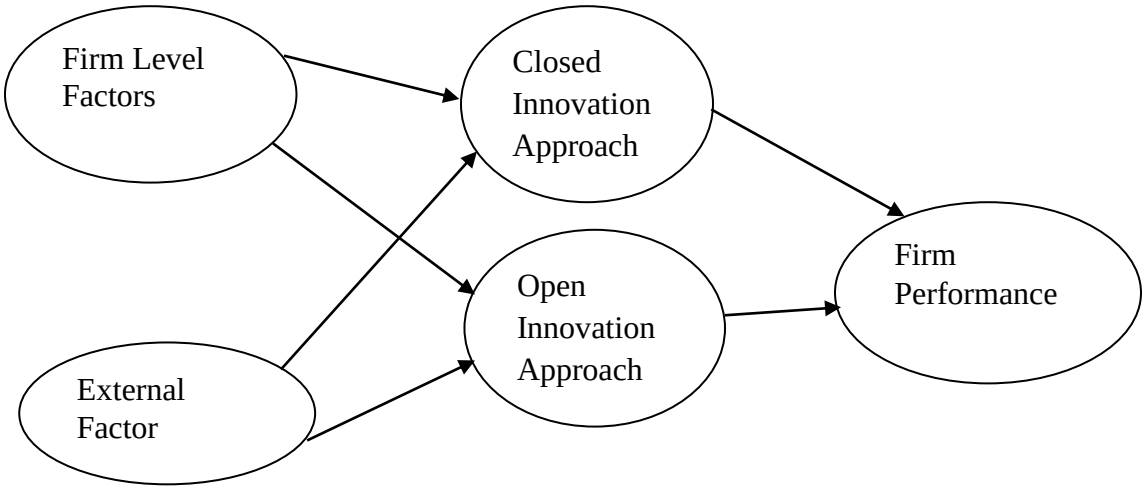

Fig 1: Conceptual Framework Source: Literature Review

3.4 Rationale of the conceptual framework

Earlier researchers have used a theoretical frame which are in silos that they have just identified the innovation practices either for market development or new product development (Chesbrough,2003;Gassman and Enkel, 2004; Wim and Nadile,2013).Also, earlier researchers such as Lichtenthaler(2008),Van de Vrande et al.(2009), Pilav-Velic and Marjonovic (2016) and other scholars have discussed on contextual factors influencing but there are no consensus among them. Also studying the contextual factors

influencing and identification of innovation approaches and its influence on firm performance were limited. Hence a comprehensive framework which connects contextual factors, innovation approaches (open and closed) and its influence on firm performance was much needed. Earlier researchers have concentrated more on open innovation practices adoption and less on firm performance. Here an attempt is made to find out factors that influence SMEs to adopt open or closed innovation practices and its influence on firm performance.

3.5 Research Questions

The research questions for the study are:

1. What are key motives and challenges for SMEs to adopt Innovation?
2. Is there an association between awareness of Innovation approach and its adoption?
3. Does firm internal factors and external factor influence to practice Open/Closed innovation approach?
4. Given the nature of Open/Closed Innovation approach adopted, How does it influence firm performance?

3.6 Research Objectives

The research objectives of the study are:

1. To search for the motives and challenges for SMEs to practice Innovation;
2. To find out the level of association between awareness and level of adoption of innovation approaches among Indian SMEs;
3. To evaluate whether the internal and external characteristics of firm influences to practices approaches of Open Innovation or Closed Innovation or both;
4. To examine the influence of Open Innovation practices on firm's performance
5. To examine the influence of Closed Innovation practices on firm's performance &
6. To determine policy implications for the promotion of Open/Closed Innovation in the SME sector.

3.7 Hypotheses Statement

SMEs have an awareness of open innovation practices and closed innovation practices. Also, these SMEs have adopted these practices of innovation. In order to test the association between awareness of innovation approach and its adoption, following hypothesis is stated.

H_{01}: There is a no significant positive association between awareness and adoption among Innovation approaches.
$H_{A1:}$ There is a significant positive association between awareness and adoption among Innovation approaches.

Adoption of Innovation among SMEs is influenced by firm-level factors or external factors or both firm level and external factors to the firm. Hence in order to test the influence of these factors on the adoption of innovation approach among SMEs, following hypothesis is stated.

H_{02a}: There is no significant influence of internal factors of the firm to adopt Innovation approach
H_{A2a}: There is a significant influence of internal factors of the firm to adopt Innovation approach

H_{02b}: There is no significant influence of external factors of the firm to adopt Innovation approach
H_{A2b}: There is a significant influence of external factors of the firm to adopt Innovation approach

H_{02c}: The internal level factors and external level factors together do not significantly influence to adopt innovation approach.

H_{A2c}: The internal level factors and external level factors together do significantly influence to adopt innovation approach

Innovation approach practiced influences firm performance of SMEs. Hence to test the influence of SMEs adoption of open innovation approach or closed innovation approach on its firm performance, following hypothesis is stated.

H_{03a1}: Practices of Open Innovation approaches do not significantly improve performance of the firm

H_{A3a1}: Practices of Open Innovation approaches do significantly improve performance of the firm

H_{03a2}: Practices of Open Innovation approaches do not significantly influence the firm's market share

H_{A3a2}: Practices of Open Innovation approaches do significantly influence the firm's market share

H_{03a3}: Practices of Open Innovation approaches do not significantly influence the firm's Revenue

H_{A3a3}: Practices of Open Innovation approaches do significantly influence the firm's Revenue

H_{03a4}: Practices of Open Innovation approaches do not significantly influence the firm's Product Sales

H_{A3a4}: Practices of Open Innovation approaches do significantly influence the firm's Product Sales

H_{03a5}: Practices of Open Innovation approaches do not significantly influence firms to develop more products

H_{A3a5}: Practices of Open Innovation approaches do significantly influences firms to develop more products

H_{04a1}: Practices of Closed Innovation approaches do not significantly improve performance of the firm

H_{A4a1}: Practices of Closed Innovation approaches do significantly improve performance of the firm

H_{04a2}: Practices of Closed Innovation approaches do not significantly influence the firms market share

H_{A4a2}: Practices of Closed Innovation approaches do significantly influence the firms market share

H_{04a3}: Practices of Closed Innovation approaches do not significantly influence the firm's Revenue

H_{A4a3}: Practices of Closed Innovation approaches do significantly influence the firm's Revenue

H_{04a4}: Practices of Closed Innovation approaches do not significantly influence the firm's Product Sales

H_{A4a4}: Practices of Closed Innovation approaches do significantly influence the firm's Product Sales

H_{04a5}: Practices of Closed Innovation approaches do not significantly influence the firms to develop more products

H_{A4a5}: Practices of Closed Innovation approaches do significantly influence the firm to develop more products

3.8 Summary

This chapter provides the insights of the research problem, conceptual framework, research questions, research hypothesis and hypothesis developed. This would help in the development of research design.

Chapter 4

Research Design

4.1 Introduction

This chapter describes the research design of the study. The chapter is divided into seven sections. The first section explains the need for a good research design; the second section explains research approach and the third section deals with data collection methods and sources of data. The fourth section describes the development of the instrument and fifth section describes sampling design. The sixth section briefly explains the sampling procedure, and the seventh section discusses the study setting. The literature review provides the theoretical basis for designing the study and collection of data. The nature of research problem leads to the choice of exploratory method & case study method and use of quantitative and qualitative methodology.

4.2 Research Design

The research design is the blueprint for the collection, measurement, and analysis of data (Cooper and Schindler, 2007). Research design refers to the logical flow of the inquiry and has to be consistent with the reality that is being investigated. Research methods, being distinct from research design, specify the mode of data collection while research methodology provides the theoretical foundation for using a particular research method (Wahyuni, 2012). A pragmatic approach to developing a research design would be, to begin with, a research purpose and research questions (Saunders et al., 2009). A good research design would contribute for a better understanding of the subject matter being researched.

On the basis of objectives, research can be classified as exploratory, descriptive and causal. Exploratory research refers to a situation where the goal of the research is to discover ideas and insights. It is conducted in order to increase one's understanding of a situation that is unfamiliar. The goal of the descriptive research is to describe the

population with respect to important variables. This involves describing characteristics of certain groups, determining proportions of the group who behave in a certain way and verifying relations between variables. Descriptive studies could be cross-sectional or longitudinal. Causal research is used to establish cause-effect relationships between variables.

In this study, the conceptual model is developed based on a review of literature and identification of variables such as firm performance, Innovation Approaches, Firm-level factors and external factors could be exploratory in nature and the results of the cross-sectional survey could be termed as descriptive. Since the study is limited to firms of Bangalore city, the design can be termed as case method. Hence the research design adopted here is a mixed research design.

4.2.1 Research Approach

A Case study method is suitable when a complex issue requires in-depth analysis. This method emphasizes detailed contextual analysis of quantitative and qualitative data to explain both the process and outcome of a program, a phenomenon or entity (Tellis, 1997). It is an empirical inquiry into a phenomenon within its real-life context in which multiple sources of evidence is used (Yin, 1984). The researcher's mistakes case study to be a qualitative research. However, it is suitable to collect quantitative evidence especially numerical and categorical responses of subjects of the study (Yin, 1984). “How” and “why” related to a phenomenon are explored through this method. Hence, case study approach was the suitable research method, keeping in mind potential audience for the final report and research questions.

To answer broad research questions, a mixed approach with precise objectives was the choice. The study adopted a combination of both the approaches. The basis for research design qualitative first in term of approaches to innovative. Given the choice of the process, the ramification of these approaches is examined quantitatively. The rationale for developing research design is on the knowledge of theoretical framework of Henry Chesbrough. This framework is an advantage as it applies to IT

sector which is continuously innovative and needs to be examined on the foundations of Chesbrough work. The logical extension of this work is drawing up research questions followed by research objectives. During the phase of research, first, the key innovation practices of open innovation are identified i.e. Collaboration, IPR, Alliances, idea generation through literature published in the journal of repute. Also the contextual factors and firm performance indicators, motivation and challenges were identified through literature and discussion with industrial experts who have been practicing from last 10-15 years and who are in the area of software product space and also with academic experts from Institute of repute who have worked and published journal papers in the area of small business and innovation (Qualitative method). Further based on these inputs a detailed survey questionnaire was developed, administered, data were collected and analyzed using Statistical Analysis (Quantitative method).

The design of the study was based on the research purpose and research approach. Objectives 1 to 5 were addressed through quantitative methodology whereas objective 6 is the outcome of objectives.

Quantitative data from multiple sources (persons and places) and methods (surveys, interviews, and documents) were gathered. The cross-sectional data was the basis for assessing the objectives 1, 2, 3, 4 and 5. Self -administered web survey and personal interviews with respondents provided the data to study objective 1 through 5.

The study adopted a descriptive research to describe the innovation approach adopted. A mix of structured and unstructured approach facilitated a comprehensive understanding of the research problem. The structured approach pre-determined the objectives, sample design, tools of data collection and survey instruments. In addition, unstructured approach helped to understand the problems faced by the firms while adopting an innovation approach, barriers to adopting innovation and the influence of adoption of innovation on firm performance.

4.2.2 Qualitative and Quantitative Methods

A method can be either quantitative or qualitative. A quantitative method consists of collecting numerical data and aims at generalizing a phenomenon through formal analysis of the data using statistical tools. Quantitative data could be sourced from surveys, structured interviews, observations or secondary data sources like annual report of companies, industry reports, etc.

Qualitative data could be sourced from in-depth interviews, focus group discussions, open-ended questionnaires, field observations, and other sources. When qualitative methods are used, depth of information collected is more important than the size of the sample. Of late, use of a mixed method by combining both quantitative and qualitative methods has become prevalent in order to gain both broad purposes of breadth and depth of understanding and corroboration (Johnson et al., 2007)

In order to achieve the purpose of the study, it was decided to apply quantitative methods to a large extent and qualitative methods to a smaller extent. The quantitative method refers to the survey that is executed in the form of a questionnaire, which is directed at the CXO's of the Software Product firms. Through the survey, the researcher strives to determine the commonly adopted approach to innovation, the practices of the Open and Closed approach of innovation and its influence on firm performance. A qualitative method is implemented through an attempt to describe the motivators and barriers in adopting innovation approach. Quantitative methodology was adopted to collect data on factors influencing innovation adoption, and innovation practices adopted and performance of firm after the adoption of innovation whereas to collect information such motivation and challenges a qualitative method was employed using telephonic discussion, and personal interviews.

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4.2.3 Research Questions

Defining research questions is the fundamental step undertaken in any empirical study. A thorough literature review was undertaken to formulate research questions about the research problem. Four research questions are framed to study the motives and challenges for practice innovation, find out the association between awareness of innovation approach and its adoption, factors influencing to adopt innovation approach and the influence of innovation approach on firm performance. Review of the relevant literature, research questions, and research objectives provides the basis for the formulation of hypotheses in this study.

4.3 Data Collection Sources

Data is collected from both primary and secondary sources. The data such as the growth of software product firms, Innovation adoption have been collected from secondary sources. The primary data is collected from web survey in the form of a questionnaire and also a depth interview is conducted for certain qualitative aspects. The researcher has examined the data to find linkages between the research objectives and outcomes with reference to the research questions and objectives. A closed-end questionnaire is designed in accordance with research objective to capture data with respect to the demographic profile of respondents, factors influencing innovation adoption, innovation practices adopted by SMEs and its firm performance.

4.3.1 Primary Data

The study is based on primary data collected with the help of a structured questionnaire distributed to decision makers of software product SMEs. The questionnaire included questions on various constructs given in table 4.1. A five-point Likert scale is used with a scoring on 1 for strongly disagree, 2 for disagree, 3 for neither disagree nor agree, 4 for agree and 5 for strongly agree for most number of the questions and a seven point Likert scale is used for few questions with a scoring of 1 for strongly disagree, 2 for disagree, 3 for somewhat disagree, 4 for neither disagree

nor agree, 5 for somewhat agree , 6 for agree and 7 for strongly agree and for a seven-point scale for few questions with a scoring of 1 for strongly decrease, 2 for moderately decrease, 3 for marginally decrease, 4 for neither decrease nor increase, 5 for marginally increase, 6 for moderately increase and 7 for strongly increase. In order to get an assessment of the choice of innovation and several other critical decision based on business attributes, a five-point scale has been used. Further with respect to the choice of variables such as a change in revenue, change in sales and so on 7^{th} point scale emerged as there are possibilities no change minor change, moderate change and maximum change, hence 7 point scale. The even point was not considered because of the issue of innovation which requires a clear decision of accepting or not accepting it. The questionnaire is validated through review of the literature and with the help of experts. Internal consistency of the questions is established by computing Cronbach's alpha as shown in table 4.2.

Table 4.1 Constructs and their sources

Construct	Source
Innovation Approaches	Lukac et al.(2012), Xu and Zheng (2012), Chesbrough H(2003), Lichtenthaler(2009)
Firm Performance	Ozer and Tınaztepe (2014), Bala Subrahmanya (2010), Sidik (2012), Lichtenthaler(2009)
Firm External Factors	Bala Subrahmanya et al.(2010), Ebru Beyza Bayarçelik et al.(2014), Lichtenthaler(2009)
Firm Internal Factor	Lichtenthaler (2008), Ebru Beyza Bayarçelik et al.(2014), Santos et al.(2014), Bala Subrahmanya et al.(2010), Mina et al. (2014), Spithoven et al. (2011), Mazzola et al.(2012)

4.3.2 Secondary Data Sources

Secondary sources refer to information that is collected and made available by a primary source. Secondary sources of information are often collected for a special purpose, either from a theoretical study or empirical study, but can also be used to address questions in other fields of research. Most of the literature has been found through a digital library of NITK and reports published by NASSCOM and iSPIRIT.

4.3.3 Criticism of sources

Both primary and secondary sources of data may contain factors influencing the quality of the research. The survey conducted in the form of questionnaire enables to collect contemporary primary data. However, the questionnaire is susceptible to the subjective opinions of the respondents and the accuracy of their responses. The theories and literature on the research topics are new and evolving and are subject to many interpretations. The researcher has endeavored to take an objective perspective of various theories while describing and utilizing the existing theories in explaining the findings of the study.

4.3.4 Research Instrument

The final survey instrument consists of the 11-page questionnaire. The questionnaire was prepared in English. The questionnaire is divided into 4 sections and has 78 items. The first section collected the general information about the respondent and his enterprise details. Here a total of 16 items is used to gather information such as the age of respondent, his educational details, work experience details, firm funding pattern, firm size, year of establishment, ownership details and category of firm. All these details are collected on a nominal scale. The second section collected the data about factors influencing and driving the firm to adopt an innovation. These include internal level factors and external level factors. The influence of internal level factors such as Age of the firm, size of the firm, education qualification, experience, culture

of firm, and Research & Development emphasis is collected through an ordinal scale i.e. five-point Likert scale. Also, the influence of external factors such as competition, customer, ecosystem, government policies, technological advances, and drivers are collected by an ordinal scales i.e. five-point Likert scale. The third section collected the data related to practices and approach adopted by the firm. These include closed and open approach. The data is collected on an ordinal scale i.e. five-point Likert scale. Final section collects the data related to firm performance. A seven-point scale is used to collect data on firm performance. The items in the questionnaire are closed ended in nature. A preliminary pilot test involving thirty respondents was conducted before the actual survey. The questions are developed from the sources mentioned in table 4.1. Some of the questions were modified after seeking the response from the pilot respondents, and the sentences in the questionnaire were reframed.

4.3.5 Reliability and Validity of Research Instrument

Research needs consistent measurement. Measurements are reliable to the extent that they are repeatable and that any random influence which tends to make measurements different from occasion to occasion or circumstance to circumstance is a source of measurement error. Reliability of the instrument is the degree to which the instrument measures consistently at all times. The objective is to ensure that if a later researcher follows exactly the same procedure as described by an earlier researcher and conducts the same study, the latter researcher should arrive at same findings and conclusions. In this study, the researcher has utilized quantitative methods in the form of a questionnaire directed towards approaches and practices of Innovation among software product firms located in Bangalore. It is considered that the same procedure is easily applicable to similar sample across different location and should render the same results. Therefore the researcher believes that the study fulfills the reliability

criteria. However, the answers of the respondents are exposed to subjectivity. The instrument fits into the context of Bangalore city.

The rationale for internal consistency is that individual items of the scale should all be measuring the same construct and thus be highly inter-correlated (Nunnaly,1978). Cronbach's alpha is a popular measure to determine the degree of consistency amongst multiple measurements of each factor. It measures the inter-term reliability of a scale generated from a number of statements. It indicates the degree to which the items are answered in a similar manner by respondents and alpha values range from 0 to 1, with higher values indicating higher levels of internal consistency. The generally agreed upon lower limit for Cronbach's alpha is 0.70, although this may decrease to 0.50 in exploratory research (Hair et.al., 1995). Zikmund et al. (2010) opine that Cronbach's alpha value between 0.80 and 0.95 are considered to have very good reliability, between 0.70 and 0.80 are considered to have good reliability, between 0.60 and 0.70 indicates fair reliability and less than 0.6 as poor reliability. The internal reliability was calculated for the construct items and overall items of the questionnaire. The rationale behind overall items is to get a holistic picture of the instrument in terms of reliability, although there are variation in Cronbach alpha, highest at 0.802 for firm performance and least for innovation practices (0.665) in general the reliability of the instrument is acceptable as it crosses .70(exact value is .798). The reliability results are presented in table 4.2.

Table 4.2 Reliability Scores

Sl.No.	Measures	Cronbach's Alpha	Standardized Cronbach's Alpha	No. of Items
1	Firm Performance items	0.802	0.801	06
2	Innovation Practices items	0.665	0.661	14
3	Factors Influencing Innovation	0.666	0.691	22
4	Overall Items	0.798	0.819	48

These reliabilities scores are found to be acceptable (Hair et.al., 1995; Zikmund et. al., 2010). Construct Validity is conducted by the Content validity or Convergent and discriminant Validity or both (Hair et al., 2011). In the current study, the content validity of the constructs is carried out by experts who have worked extensively in the domain of innovation and SME. The convergent validity and discriminant validity is carried out using exploratory factor analysis and the results are found to be valid.

4.3.6 Scale Development

In research, to measure subjective variables such as attitudes, feelings, personal opinions, or word usage a scale has to be used. The Likert scale is the most popular attitude measurement scale used in the instrument (questionnaire) to obtain the respondent's degree of agreement with a set of subjective statements (Zikmund et al., 2010). A statement is followed by several levels of agreement: strongly disagree, disagree, neither disagree nor agree, agree and strongly agree. The Likert- type scale is also used to capture subjective response which is difficult to measure or addresses a sensitive topic, to which a respondent would probably not respond, or would falsely if asked directly. The scales used in the thesis have been developed from a review of relevant literature, and results of the pilot study. Most of the scales used are pre-tested. A total of 78 items are

used in the questionnaire in which 2 items are in string or characters, and other 76 scaled items are used to measure the constructs in the research framework as discussed in Chapter Three. The questionnaire has a 5-point Likert scale, 7-point scale, dichotomous scale and other multiple choice nominal scale.

Table 4.3 Scale Items Used in the Thesis

Construct	Variables/Attributes	Number of Items	Source
Firm Performance	Market Share	01	Ozer F and Tınaztepe C (2014),Bala Subrahmanya (2010), Bala Subrahmanya et. al(2010), Sidik I(2012), Adnan Kalkan, Özlem Çetinkaya Bozkurt and Mutlu Arman (2014), Lichtenthaler(2008),
	Product Sales	01	
	Revenue	01	
	More Products	01	
	Performance	02	
Innovation Approach	Open Innovation	21	Lichtenthaler(2008), Lukac et al(2012), Xu and Zheng (2012),Chesbrough H(2003)
	Closed Innovation	02	
Firm-level factors	Age	02	Lichtenthaler(2008), Ebru Beyza Bayarçelik et al.(2014), Santos et al.(2014), Bala Subrahmanya et al.(2010), Mina et al. (2014), A. Spithoven et al. (2011), Mazzola E et al.(2012)
	Size	02	
	Education	02	
	Experience	04	
	Research and Development	02	
	Culture	08	

External Level Factors	Competition	01	Bala Subrahmanya et al.(2010), Lichtenthaler(2009), Ebru Beyza Bayarçelik et al.(2014)
	Technological Advances	01	
	Customer	01	
	Policies of Government	01	
	Ecosystem	01	

4.4 Sample Design

The sample design consists of the population and working population of the study, Sampling frame, sample size, sampling procedure followed.

4.4.1 Sampling frame

The criterion for deciding on the population for the study is based on reports published by National Association of Software and Services Companies (NASSCOM). As per the reports published by NASSCOM, there are 3500 software product companies across India as on 2014 and among them, 28% are located in Bangalore. The report does not mention about the category of the company i.e. Small, Medium, and Big. Hence 28% of 3500 i.e. 980 companies are considered as the working population for the study. In the sampling domain (which is of larger frame) the firms have been categorized based on its size and type. The sample frame consists of the decision makers of core product firms, product and services firms and product as service or software as service firms.

4.4.2 Sample Size

For the working population of 980 firms, the sample size required at a confidence level of 95% and confidence interval of 6 is 210 without considering characteristics of interest

Confidence level at 95% and error at 0.06 leads to 210 samples. The characteristics of interest are variables and attributes identified for the study. These are the total no. of firms that need to be approached. 200 samples are found to be fairly reasonable and representative. Fairly reasonable in terms of quality of data as assessed by the reliability of the scale. The representativeness is assessed by KMO statistics which is greater than 0.5. In the current study, a sample of 213 firms has been considered. After editing the data set 213 were found to be appropriate for analysis. The 213 was retained as any information beyond 200 improves the consistency of data. The sample adequacy test also confirms that the sample size considered is adequate.

4.4.3 Sample Profile or Target Respondent

The respondent of the study is one of the following people in the following designation.

1. CEO /Managing Director / President /Founder/
2. CTO or VP –Engineering or VP – Technology
3. Co-founder
4. Product Head

4.4.4 Sampling Procedure

The study requires data to be collected from select software product firms. The software industry is categorized into two types namely product firms and services firms. Recently one more category has emerged known as a product as service firms. Since the study involves collecting data from the decision makers of the firm and keeping in mind the nature of business and size of the firm in terms of headcount. The researcher decided to adopt a mixed sampling approach. The study adopts a criterion-based sampling method and a snowball sampling. We have used criteria based sampling and snowballing. Snowballing adopted for a large sample tends to be random sampling (Zikmund et al, 2010). Initially, based on the nature of the

business, size and year of establishment, the sample unit is identified. Further, with the decision maker of the firm connect is established either my directly emailing or using social media such as LinkedIn or Facebook. Once the sample unit agrees to participate in the survey, the survey link which is prepared in google doc is sent to the respondent. Further, it is followed till the respondent participates in the survey.

4.5 Conducting the Survey

A self-administered questionnaire was used to collect data from the respondents since it is the better method when the sample size is large. An online Google document which consists of survey items is sent to the survey participant after taking their consent. The reminder emails are sent to the participants till a response received from them. On an average two reminders was sent for those who did not respond.

4.6 Study Setting

A number of software product firms have grown over the last decade from a little over 100 in 2000 to nearly 3500 in 2014. As per NASSCOM, the revenue from the software product segment currently stands at 2.2 billion USD and is expected to reach 10 billion USD by 2020. India's software product industry think-tank, in their first 'Product Industry Monitor Report (PIM),' analyzes India's software product industry landscape. The think-tank estimates that the Indian software product industry has the potential to grow USD 100 billion by 2025, contributing significantly to the nation's current account. The think tank feels that the software product industry has all the fundamental requirements in place to succeed.

The domestic market for software products is expected to grow at 14%, almost three times the global growth rate. A good part of this increased demand for software products will come from the SME sector and India's growth engine and socially significant sectors such as healthcare and education that are struggling to scale up to meet the needs of a growing nation (iSPIRIT 2014). Hence the software product firm in the SME sector is chosen for the study.

The Software Product segment of Indian software industry are classified as follows:

1. Core product only firms
2. Product as a service firms
3. Product and service firms

This classification was arrived based on the discussion with the regional director of NASSCOM and Head of NASSCOM 10k Startup and the then general manager of KBITS, GoK, Bangalore. Hence the above type of firms was studied. Among these types of firms, there exist homogeneity in terms of nature of business, technology adoption, product development and markets served. All these types of firm fall under the category of MSME or SME as categorized by NASSCOM. Bangalore is the hub of the software industry and more than 28% of the total Indian software product firms are located in Bangalore (Nasscom, 2014). Hence the study is limited to Bangalore city.

4.7 Tools used to analyze data

The data has to be analyzed to find the linkages between the objectives and the outcomes with reference to the research questions. Hence the researcher classifies, tabulate and recombines the data to address the purpose of the study, and the data is cross-checked to avoid discrepancies. Statistics such as frequency tables and cross tabulation, Chi-Square Test, Kruskal-Wallis Test, Multinomial Logistic Regression and Ordinal Logistic Regression are used to analyze the dataset.

4.7.1 Chi-Square Test

The Chi-Square test is performed when there are two categorical variables from a single population. Chi-square test asses the sampling adequacy. The same statistic is used for

assessing differentiation in terms of levels of association and adoption between attributes. Chi-Square (X^2) test is used to determine whether there is a significant association between the two variables. Snowballing adopted for a large sample tends to be random sampling (Zikmund et al, 2010) Hence in this case sampling becomes random in nature thus chi-square is adopted.

This test appropriate when the following conditions are met:

1. The sampling method is simple random sampling.
2. The variables under study are each categorical.
3. If sample data are displayed in a contingency table, the expected frequency count for each cell of the table is at least 5.

This test is computed using the following formula

$\chi^2 = \Sigma [(O - E)^2 / E]$

Where O is the observed frequency count, and E is the expected frequency count

4.7.2 Kruskal-Wallis Test

The Kruskal-Wallis test evaluates whether the population medians on a dependent variable are the same across all the levels of a factor. To conduct the Kruskal- Wallis test a K- independent sample procedure is adopted, and cases must have scored on a grouping variable and on test a variable. The grouping variable divides individuals into two or more groups, and the test variables assess individuals or groups. The purpose KW test is it fits in well for variation across attribute category. Firms are driven by individuals (decision Makers) to form our target group. Hence this test is applicable.

This test is appropriate for use under the following circumstances:

1. There must be three or more conditions for comparison
2. Each condition is performed by a different group of participants
3. The data does not meet the requirements for a parametric test i.e. if the data set is not normally distributed.

Kruskal-Wallis test is performed to find out the difference in groups of SMEs in adoption of innovation practices

4.7.3 Multinomial Logistic Regression

The multinomial logistic regression model is a simple extension of the binomial logistic regression model. They are used when the dependent variable has more than two nominal (unordered) categories. Multinomial logistic regressions find the equation that best predicts the value of the Y variable for the values of the X variables. The Y variable is the probability of obtaining a particular value of the nominal variable. Taking the natural log of the odds makes the variable more suitable for a regression, so the result of a multinomial logistic regression is an equation that is represented as:

$\ln[Y/(1-Y)] = a+b_1X_1+b_2X_2+b_3X_3.....+b_nX_n +e$

Where b1, $b_2 \ldots b_n$, etc. are the parameter estimates, a is the intercept and e are residual.

In the current study, Adoption of Innovation approach i.e. Open Innovation, Closed Innovation is dependent variable and firm-level factors and External factors influencing innovation are the independent variables.

4.7.4 Ordinal Logistic Regression

Ordinal logistic regression is a member of the family of regression analysis. Ordinal logistic regression describes data and explains the relationship between one dependent variable and two or more independent variables. In ordinal logistic regression analysis, the dependent variable is ordinal (statistically, it is polytomous ordinal) and the independent variables are ordinal or continuous-level (ratio or interval).

The general form of an ordinal logistic model is represented as follows:

$Ln(Y') = \alpha_j – (\beta 1X1+ \beta_2X_2+ \beta_3X_3+\ldots\ldots+ \beta_nX_n) + €$ …….. (1)

Where β1, β2, β3… βn are logit coefficients. When there are j categories, the Proportional Odds model estimates J-1 cut points and € is the residual.

In the current study, firm performance i.e. Overall, Change in Market Share, Change in Sales, Change in Revenue, More product development is the dependent variable and the open innovation practices and closed innovation practices are the independent variables

4.8 Summary

Research design briefly describes the blueprint that the researcher has used for the collection, measurement, and analysis of data in order to better understand the topic of Innovation approach adoption and its influence on firm performance among software product SMEs. In view of the fact that research related software product SMEs limited to Bangalore, to the best of the researcher's knowledge, this research uses both inductive and deductive reasoning. The conceptual model is deduced from relevant literature on innovation and SMEs. A questionnaire survey is conducted among the decision makers of software product firm located in Bangalore to empirically test the conceptual framework. This forms the inductive framework of the study. The research is both exploratory and descriptive limited to the case of Bangalore. In order to achieve the purpose of the study, quantitative as well as qualitative methods have been applied. Data was collected primarily through a survey of 200 decision makers of software product firms in the form of self-administered web survey as well as interviewing about 10 experts who are owners of software firms, senior members of a trade association and domain experts in the area of Innovation. The survey instrument consisted of the 11-page questionnaire. A total of 78 items were used. 16 items collected basic profile of the firm which was measured on a nominal scale, 33 items collected the factors that influence and drives innovation in the firm and awareness and adoption of innovation. These were measured on an ordinal scale (5-point Likert scale) and nominal scales. 23 items collected innovation approaches and were measured on an ordinal scale (5-point Likert scale) and 6 items collected data on firm performance and were measured on a 7-point scale. The secondary sources of information were gathered from books, research papers published in journals and industry reports. Most of the literature were found through NITK Digital library. The validity of the instrument was obtained with the help of experts and pilot tested for a small group of

respondents and reliability was tested using Cronbach's alpha. The criterion for deciding on the population was (i) Firm should be located in Bangalore (ii) Firms should be in the business line of the core product, or product and service or product as service category (iii) Headcount of the firm should be less than 250. Since the selection of survey participant had many criteria, a criterion-based sampling and snowball sampling is used for the purpose of the study. Data collected is analyzed using SPSS 21 version. Statistical tools such as Chi-Square Test, Kruskal-Wallis Test, Multinomial Logistic Regression and Ordinal Regression are used to analyze the data set for inference and interpretation.

Chapter 5

SMEs Profile and Adoption of Innovation

5.1 Introduction

This chapter describes the profile of SMEs and its respondents. Respondents profile in terms respondent age, designation, education profile, marital status, gender, work experience details. The SMEs profile includes Age of the firm, Size of the firm, Year of the establishment, Ownership pattern, funding type, markets served, the investment made, R & D investment, Products owned by the firm, IPR owned by the firm. The motivation to adopt innovation and challenges faced by the firm in the adoption of innovation is also described. The awareness of SMEs with respect to innovation, adoption with respect to innovation and also the association between awareness of innovation approach and its adoption among the SMEs is detailed.

5.2 Profile of the sample firms

5.2.1 Age of the respondent

Table 5.1 Respondent's Age and Adoption of Innovation

Respondent's Age	Adoption of Innovation			Total	KW Test		
	Open Innovation	Closed Innovation	Both		Chi-Square	df	Sig
25-30	12	4	11	27	0.646	2	0.724
31-35	8	3	20	31			
36-40	13	7	31	51			
41-45	17	5	26	48			
46-50	9	6	15	30			
Above 50	6	3	17	26			
Total	65	28	120	213			

Source: Survey Output

Table 5.1 discusses the age of the respondents (decision makers). 12.67% of the respondents are in the age group of 25-30. 14.55% of the respondents are in the age group of 31-35. 23.94% of the respondents are in the age group of 36-40. 22.53% of the respondents are in the age group of 41-45. 14.08% of the respondents are in the age group of 46-50. 12.20% of the respondents are in the age group of above 50. Among the age group of 25-30, 44.44% have adopted an open innovation, 14.81% have adopted a closed innovation, and 40.74% have adopted both the approaches. Among the age group of 31-35, 25.80% of the respondents have adopted open innovation practices, 9.61% of the respondents have adopted closed innovation practices, and the remaining 64.59% have adopted both the practices. Among the age group of 36-40, 25.5% have adopted an open innovation, 13.72% have adopted a closed innovation, and 60.78% have adopted both the approaches. Among the age group of 41-45, 35.41% of the respondents have adopted an open innovation, 10.41% have adopted a closed innovation, and 54.16% have adopted both the approaches. Among the age group 46-50, 30% of the respondents have adopted an open innovation, 20% have adopted a closed innovation, and 50% of the respondents have adopted both the approaches. Among the age group of above 50, 23.07% of the respondents have adopted an open innovation, 11.54% have adopted a closed innovation, and 65.39% have adopted both the innovation approaches.

From the Kruskal-Wallis Test, it is clear that there is no difference in adoption of innovation approaches among the SME age groups of the respondents since the p-value is insignificant at 99%, 95%, and 90% significance level.

5.2.2 Designation of the respondent

Table 5.2 Respondent Designation and Adoption of Innovation

Respondent Designation	Adoption of Innovation			Total	KW Test		
	Open Innovation	Closed Innovation	Both		Chi-Square	df	Sig
CEO/MD/President	34	14	64	112	0.156	2	0.925
CTO/VP-Engg/VP-Tech	10	4	8	22			
Co-founder	19	9	43	71			
Product Heads	0	0	2	2			
Others	2	1	3	6			
Total	65	28	120	213			

Source: Survey Output

Table 5.2 discusses the respondent profile in terms of designation and their adoption of innovation. About 52.58% of the respondents are designated as CEOs or MD or President. About 10.33% are designated as CTO or VP-Engineering or VP- Technology. About 33.33% are designated as co-founders. About 0.94% is designated as Product Heads, and about 2.82% are designated as other decision makers. Among the CEOs or MD or President designated group, about 30.36% have adopted an open innovation, 12.5% have adopted a closed innovation, and 57.14% have adopted both the innovation approaches. Among the CTO or Vice President-Engineering or Vice President-Technology designated group, 45.45% have adopted an open innovation, 18.18% have adopted a closed innovation, and 36.37% have adopted both the approaches. Among the group designated as co-founders, 26.77% have adopted an open innovation, 12.77% have adopted a closed innovation, and 60.56% have adopted both the approaches. Among the group designated as product heads, all the respondents have adopted both the approaches.

Among the group designated as others, 33.33 have adopted an open innovation, 16.67% have adopted a closed innovation, and 50% have adopted both the approaches.

From the Kruskal-Wallis test, it is clear that there is no difference among the group in the adoption of innovation. This could be found that since the p-value is > 0.05. KW statistics in most cases are 0.10. This suggests the degree of differentiation of attributes. However, the degree of association are extracted with respect to firms.

5.2.3 Education of the respondent

Table 5.3 Respondent Education and Adoption of Innovation

Respondent Education	Adoption of Innovation			Total	KW Test		
	Open Innovation	Closed Innovation	Both		Chi-Square	df	Sig
Bachelor's	33	11	45	89	3.732	2	0.155
Master's	30	14	67	111			
Doctoral	2	3	5	10			
Others	0	0	3	3			
Total	65	28	120	213			

Source: Survey Output

Table 5.3 provides the details about the education qualification of the respondents and their adoption of innovation approach. 41.78% of the respondents have a Bachelor's degree, 52.11% have a Master's degree, 43.48% have a doctoral degree and the remaining 1.41% is non-graduates. Among the Bachelor's, 37.07% have adopted an open innovation, 12.36% have adopted a closed innovation, and 50.56% have adopted both the approaches. Among the Master's, 27.02% have adopted an open innovation, 12.61% have adopted a closed innovation, and 60.37 have adopted both the approaches. Among the Doctorates, 20% have adopted an open innovation, 30% have adopted a closed

innovation, and 50% have adopted both approaches. The others have adopted both the approaches.

From the Kruskal-Wallis Test, it is clear that there is no difference among the groups to adopt innovation since the p-value is insignificant.

5.2.4 Type of Education

Table 5.4 Type of Education and Adoption of Innovation

Type of Education	Adoption of Innovation			Total	KW Test		
	Open Innovation	Closed Innovation	Both		Chi-Square	df	Sig
Technical	57	23	105	185	0.625	2	0.732
Non -Technical	8	5	15	28			
Total	65	28	120	213			

Source: Survey Output

The respondents who are technically qualified are 86.85% and with non-technical qualified are 13.15%. From the table 5.4, it can be seen that among the technical group, 30.81% have adopted an open innovation, 12.43% have adopted a closed innovation, and 56.76% have adopted both the approaches. Among the technical group, 28.57% have adopted an open innovation, 17.86% have adopted a closed innovation, and 53.57% have adopted both the approaches.

From the Kruskal-Wallis Test, it is clear that there is no difference among the groups to adopt Innovation since the p-value is insignificant at p-value is > 0.05.

5.2.5 Gender of the respondents.

Table 5.5 Gender of Respondent and Adoption of Innovation

Gender of Respondent	Adoption of Innovation			Total	KW Test		
	Open Innovation	Closed Innovation	Both		Chi-Square	df	Sig
Male	59	27	115	201	2.281	2	0.320
Female	6	1	5	12			
Total	65	28	120	213			

Source: Survey Output

From the table 5.5, it is clear that the sample is biased towards male respondents. 94.37% are male respondents, and only 5.63% are female respondents. Among the male respondents, 29.35% have adopted an open innovation, 13.43% have adopted a closed innovation, and 57.21% have adopted both the approaches. Among the female respondents, 50% have adopted an open innovation, 8.33% have adopted a closed innovation, and 41.67% have adopted both the approaches.

From the Kruskal-Wallis Test, it is clear that there is no difference in adoption of innovation approaches since the p-value is >0.05

5.2.6 Marital Status

Table 5.6 Marital Status and Adoption of Innovation

Marital Status	Adoption of Innovation			Total	KW Test		
	Open Innovation	Closed Innovation	Both		Chi-Square	df	Sig
Single	10	6	14	30	1.910	2	0.385
Married	55	22	106	183			
Total	65	28	120	213			

Source: Survey Output

Table 5.6 describes the marital status of the respondents and their adoption of innovation. 14.08% of the respondents are single and 85.92% respondents are married. Among the respondents who are single, 33.33% have adopted an open innovation, 20% have adopted a closed innovation, and 46.67% have adopted both the approaches. Among the respondents who are married, 30.05% have adopted an open innovation, 12.02% have adopted a closed innovation, and 57.92% have adopted both the approaches.

From the Kruskal-Wallis results, it is clear that there is no difference in adoption of innovation among the groups based on marital status.

5.2.7 Total Work Experience

Table 5.7 Total Work Experience and Adoption of Innovation

Total Work Experience in Years	Adoption of Innovation			Total	KW Test		
	Open Innovation	Closed Innovation	Both		Chi-Square	df	Sig
Less than or equal 5	8	1	5	14	0.651	2	0.722
6-10	8	5	13	26			
11-15	9	2	26	37			
16-20	17	9	34	60			
Above 20	23	11	42	76			
Total	65	28	120	213			

Source: Survey Output

The table 5.7 describes the total work experience of the respondents and their adoption of innovation approach.6.57% of the respondents have a work experience of less than or equal to 5 years, 12.20% have an experience of 6-10 years, 17.37% have an experience of 11-15 years, 28.17% have an experience of 16-20 years and 35.68% have an experience of 20 years and above. Among the respondents who have an experience of fewer than 5 years, 57.14 % have adopted an open innovation, 7.14% have adopted a closed innovation, and 35.72% have adopted both the approaches. Among the respondents who have an experience of 6-10 years, 30.77% have adopted an open innovation, 19.23% have adopted closed innovation & 50% have adopted both innovation approaches. Among the respondents who have work experience of 11-15 years, 24.32% have adopted an open innovation, 5.41% have adopted a closed innovation, and 70.27% have adopted both the approaches. Among the respondents who have an experience of 16-20 years, 28.33% have adopted an open innovation, 15% have adopted a closed innovation, and 56.67% have adopted both the approaches. Among the respondents who have an experience of 20

years and above, 30.27% have adopted an open innovation, 14.47% have adopted a closed innovation, and 55.26% have adopted both the approaches.

From the Kruskal-Wallis results, it is clear that there is no difference in adoption of innovation among the groups based on total work experience as the p-value is found to be insignificant.

5.2.8 Experience in SMEs

Table 5.8 Experience in SME and Adoption of Innovation

Experience in SME in years	Adoption of Innovation			Total	KW Test		
	Open Innovation	Closed Innovation	Both		Chi-Square	df	Sig
Less than or equal to 5	29	8	38	75	1.332	2	0.514
6-10	15	7	44	66			
11-15	7	8	18	33			
16-20	5	4	13	22			
Above 20	9	1	7	17			
Total	65	28	120	213			

Source: Survey Output

Table 5.8 describes the work experiences of respondents in SMEs and their adoption of innovation approach. 35.21%, respondents have an experience of fewer than 5 years in SMEs.

30.99% respondents have an experience of 6-10 years. 15.49% %, respondents have an experience of 11-15 years, 10.33% respondents have an experience of 16-20 years. 7.98% respondents have an experience of Above 20 years. Among the respondents who have an experience of less than or equal to 5 years, 38.67% have adopted an open innovation, 10.67% have adopted a closed innovation, and 50.66% have adopted both the approaches.

Among the respondents who have experience in SMEs about 6- 10 years, 22.73% have adopted an open innovation, 10.60% have adopted a closed innovation, and 66.67% have adopted both the approaches. Among the respondents who have experience in SMEs about 11- 15 years, 21.21% have adopted an open innovation, 24.24% have adopted a closed innovation, and 54.54% have adopted both the approaches. Among the respondents who have experience in SMEs about 16- 20 years, 22.72% have adopted an open innovation, 18.18% have adopted a closed innovation, and 59.10% have adopted both the approaches. Among the respondents who have an experience in SMEs above 20 years, 52.94% have adopted an open innovation, 5.89% have adopted a closed innovation, and 41.17% have both approaches.

From the KW test, since p-value is >0.05 there is no difference among the respondent groups based on experience in SME in adopting innovation practices or approaches.

5.2.9 Experience in current firm

Table 5.9 Experience in Current firm and Adoption of Innovation

Experience in Current firm	Adoption of Innovation			Total	KW Test		
	Open Innovation	Closed Innovation	Both		Chi-Square	df	Sig
Less than or equal to 5	56	16	83	155	10.206	2	0.006
6-10	7	8	26	41			
11-15	1	3	6	10			
16-20	0	0	4	4			
Above 20	1	1	1	3			
Total	65	28	120	213			

Source: Survey Output

Table 5.9 describes the work experiences of respondents in the current firm and their adoption of innovation approach. 72.77%, respondents have an experience of fewer than 5 years in the current firm. 19.25% respondents have an experience of 6-10 years. 4.69 %, respondents have an experience of 11-15 years, 1.88% respondents have an experience of 16-20 years. 1.41% respondents have an experience of Above 20 years. Among the respondents who have an experience of less than or equal to 5 years, 36.13% have adopted an open innovation, 10.32% have adopted a closed innovation, and 53.55% have adopted both the approaches. Among the respondents who have experience in SMEs about 6- 10 years, 17.07% have adopted an open innovation, 19.51% have adopted a closed innovation, and 63.41% have adopted both the approaches. Among the respondents who have experience in SMEs about 11- 15 years, 10% have adopted an open innovation, 30% have adopted a closed innovation, and 60% have adopted both the approaches. Among the respondents who have an experience in SMEs about 16- 20 years, all the respondents have adopted both the approaches. Among the respondents who have an experience in SMEs above 20 years, 33.33% have adopted an open innovation, 33.33% have adopted a closed innovation, and 33.33% have both approaches. From the KW test, since p-value is < 0.05, it can be said that there is a difference among this respondent groups in adopting innovation practices or approaches.

5.2.10 Previous Experiences of Decision maker

Table 5.10 Previous Experiences and Adoption of Innovation

Previous Experiences	Adoption of Innovation			Total	KW Test		
	Open Innovation	Closed Innovation	Both		Chi-Square	df	Sig
SME Only	15	3	19	37	1.321	2	0.517
MNC Only	16	8	27	51			
R & D Labs Only	1	1	1	3			
All the three	15	6	41	62			
SME and MNC	11	6	23	40			
SME and R & D	1	1	1	3			
MNC and R & D	6	3	8	17			
Total	65	28	120	213			

Source: Survey Output

The table 5.10 describes the previous experience of the respondents. About 29.11 % of the respondents have an experience in all the three categories of the firms. About 23.94% have an experience in MNC's only. 18.77% have an experience in both SME and MNC. 17.37% have an experience in only SMEs. 7.98% have an experience in MNC and R&D firms. 1.41% has experience in R&D labs and in SME and R&D labs respectively. Among the respondents who have previous experience in SMEs alone, 40.54% have adopted an open innovation, 8.11% have adopted a closed innovation, and 51.35% have adopted both innovation approaches. Among the respondents who have previous experience in MNC only, 31.37 % have adopted an open innovation, 15.69% have adopted a closed innovation, and 52.94% have adopted both innovation approaches. Among respondents who have previous experience in R & D labs alone, 33.33% have adopted an open innovation, 33.33% have adopted a closed innovation, and 33.34% have

adopted both approaches. Among respondents who have previous experience in R & D labs and in SMEs, 33.33% have adopted an open innovation, 33.33% have adopted a closed innovation, and 33.34% have adopted both approaches. Among the respondents who have experience in all the three categories, 24.19% have adopted an open innovation, 9.68% have adopted a closed innovation, and 66.13% have adopted both approaches. Among the respondents who have an experience in SME and MNCs, 27.5 % have adopted an open innovation, 15% have adopted a closed innovation, and 57.5 have adopted both the approaches. Among the respondents who have previous experience in MNC and R & D Labs, 35.29% have adopted an open innovation, 37.5% have adopted a closed innovation, and 27.21% have adopted both the approaches.

From the KW test, it is clear that there is no difference in groups with respect to their previous experience in the adoption of innovation.

5.2.11 Year of Establishment

Table 5.11 Year of Establishment and Adoption of Innovation

Year of Establishment	Adoption of Innovation			Total	KW Test		
	Open Innovation	Closed Innovation	Both		Chi-Square	df	Sig
2010-2015	56	17	90	163	6.769	2	0.034
2005-2009	6	9	22	37			
2000-2004	2	1	3	6			
1995-1999	0	1	3	4			
Before 1995	1	0	2	3			
Total	65	28	120	213			

Source: Survey Output

Table 5.11 provides the information about the innovation approach adopted with respect to the firm establishment. 76.52 % of the respondents have established their firm between the period 2010 & 2015. Among them, 34.36% have adopted an open innovation, 10.43% have adopted a closed innovation, and 55.21% have adopted both the approaches. 17.37 % of the respondents have established their firm during 2005-2009. Among them, 16.22% have adopted an open innovation, 24.32% have adopted a closed innovation, and 59.46% have adopted both the approaches. 2.82 % of the respondents have established their firm during 2000-2004. Among them, 33.33% have adopted an open innovation, 16.67% have adopted a closed innovation, and 50% have adopted both the approaches. 1.88 % of the respondents have established their firm during 1995-1999. Among them, none have adopted an open innovation, 25% have adopted a closed innovation, and 75% have adopted both the approaches. 1.41 % of the respondents have established their firm before 1995. Among them, none have adopted a closed innovation, 33.33% have adopted an open innovation, and 66.67% have adopted both the approaches. From the KW test, it

is clear that there is the difference in groups with respect to their year of establishment and innovation approach adopted.

5.2.12 Firm Ownership

Table 5.12 Firm Ownership and Adoption of Innovation

Firm Ownership	Adoption of Innovation			Total	KW Test		
	Open Innovation	Closed Innovation	Both		Chi-Square	df	Sig
Proprietary	1	2	4	7	3.064	2	0.216
Partnership	3	0	13	16			
Private Ltd	61	26	103	190			
Total	65	28	120	213			

Source: Survey Output

The table 5.12 describes the ownership of the firm and innovation adoption. 0.47% of the respondent firms are proprietary in nature, 7.5% of the respondents have partnership firms, and 89.21% of the firms are Private limited. Among them 30.52% have adopted an open innovation, 13.15 have adopted a closed innovation, and 56.33% have adopted both the approaches.

From the KW test, it is clear that there is no difference in adoption of innovation among the SME groups based on ownership.

5.2.13 Type of firm

Table 5.13 Type of Firm and Adoption of Innovation

Type of Firm	Adoption of Innovation			Total	KW Test		
	Open Innovation	Closed Innovation	Both		Chi-Square	df	Sig
Product Only	14	7	26	47	1.650	2	0.438
Product and services	26	15	54	95			
Product as Service	25	6	40	71			
Total	65	28	120	213			

Source: Survey Output

The table 5.13 describes the type of the firm and innovation adoption. 22.07% of the respondent firms are a product only firm, 44.60% of the respondents are product and services firm, and 33.33% of the respondents are a product as services firm. Among the product only firms, 29.79% have adopted an open innovation, 14.89% have adopted a closed innovation, and 55.32% have adopted both the approaches. Among the Product and services firms, 27.37% have adopted an open innovation, 15.79% have adopted a closed innovation, and 56.84% have adopted both the innovation approaches. Among the Product as Service firms, 35.21% have adopted an open innovation, 8.45% have adopted a closed innovation, and 56.34% have adopted both the approaches.

From the KW test, it is clear that there is no difference in adoption of innovation among the SME groups based on the type of firm.

5.2.14 Funding pattern of the SMEs

Table 5.14 Funding Pattern and Adoption of Innovation

Funding Pattern	Adoption of Innovation			Total	KW Test		
	Open Innovation	Closed Innovation	Both		Chi-Square	df	Sig
Fully Self-Funded	33	16	58	107	0.499	2	0.779
Self-Funded with Angel Investor	25	8	46	79			
Fully Funded by VC	7	4	16	27			
Total	65	28	120	213			

Source: Survey Output

The table 5.14 describes the funding pattern of the firm and innovation adoption. 50.23% of the respondent firms are self-funded, 37.08% of the respondents are self-funded with angel investors, and 12.67% of the firms are fully funded by venture capitals. Among the self-funded firms, 30.84% have adopted an open innovation, 14.95% have adopted a closed innovation, and 54.21% have adopted both the approaches. Among the self-funded and Angel invested firms, 31.65% have adopted an open innovation, 10.13% have adopted a closed innovation, and 58.22% have adopted both the innovation approaches. Among the venture capitalist funded firms, 25.93% have adopted an open innovation, 14.81% have adopted a closed innovation, and 59.26% have adopted both the approaches. From the KW test, it is clear that there is no difference in adoption of innovation among the SME groups based on funding pattern.

5.2.15 Age of the firm

Table 5.15 Age of the Firm and Adoption of Innovation

Age of the Firm	Adoption of Innovation			Total	KW Test		
	Open Innovation	Closed Innovation	Both		Chi-Square	df	Sig
0-5	55	15	83	153	10.063	2	0.007
6-10	8	10	28	46			
11-15	1	2	4	7			
16-20	0	1	3	4			
Above 20	1	0	2	3			
Total	65	28	120	213			

Source: Survey Output

The table 5.15 describes the age of the firm and their adoption of innovation approach. 71.83% of SMEs have an age of less than or equal to 5 years. 21.60% SMEs have an age of 6-10 years. 3.29 %, respondents have an experience of 11-15 years, 1.88% respondents have an age of 16-20 years. 1.40% respondents have an age of Above 20 years. Among the SMEs who have an age of less than or equal to 5 years, 35.95% have adopted an open innovation, 9.80% have adopted a closed innovation, and 54.25% have adopted both the approaches. Among the SMEs whose firm age is about 6- 10 years, 17.4% have adopted an open innovation, 21.74% have adopted a closed innovation, and 60.87% have adopted both the approaches. Among the SMEs whose firm age is about 11- 15 years, 14.29% have adopted an open innovation, 28.57% have adopted a closed innovation, and 57.14% have adopted both the approaches. Among the SMEs whose firm age is about 16- 20 years, none have adopted an open innovation, 25% have adopted a closed innovation, and 75% have adopted both the approaches. Among the SMEs whose firm age is above 20 years, 33.33% have adopted an open innovation, none have adopted a closed innovation, and 66.67% have adopted both approaches.

From the KW test, since p-value is < 0.05, it can be said that there is a difference among this firm age of the SMEs in adopting innovation practices or approaches.

5.2.16 Size of the Firm

Table 5.16 Size of the Firm and Adoption of Innovation

Size of the Firm	Adoption of Innovation			Total	KW Test		
	Open Innovation	Closed Innovation	Both		Chi-Square	df	Sig
0-10	17	10	39	66	.001	2	1.000
11-20	21	4	24	49			
21-30	8	3	17	28			
31-40	2	2	8	12			
41-50	6	4	8	18			
51-100	7	4	17	28			
101-250	4	1	7	12			
Total	65	28	120	213			

Source: Survey Output

Table 5.16 describes the adoption of innovation approaches by SMEs of different size. 30.99% of the SMEs have a size of less than or equal10 employees. 23% of the SMEs have a head count of 11-20, 13.15% have a head count of 21-30, and 5.63% have a head count of 31-40, 8.45% of SMEs have a head count of 41-50, 13.15% of SMEs have a head count of 51-100 and 5.63% have a head count of 101-250. Among the SMEs with a headcount of less than or equal to 10, 25.76% have adopted an open innovation, 15.15% have adopted a closed innovation, and 59.09% have adopted both the approaches. Among the SMEs with a headcount of 11-20, 42.86% have adopted an open innovation, 8.16% have adopted a closed innovation, and 48.98% have adopted both the approaches. Among the SMEs with a headcount of 21-30, 28.57% have adopted an open innovation, 10.71% have adopted a

closed innovation, and 60.72% have adopted both approaches. Among the SMEs with a headcount of 31-40, 16.67% have adopted open innovation and closed innovation each, and 66.66% have adopted both the approaches. Among the SMEs with a headcount of 41-50, 33.33% have adopted an open innovation, 22.22% have adopted a closed innovation, and 44.44% have adopted both approaches. Among the SMEs with a headcount of 51-100, 25% have adopted an open innovation, 14.29 % have adopted a closed innovation, and 60.71% have adopted both the approaches. Among the SMEs with a headcount of 101-250, 30.77% have adopted an open innovation, 8.33% have adopted a closed innovation, and 58.33% have adopted both the approaches.

From the KW test, it is clear that there is no difference in adoption of innovation among the SME groups based on headcount.

5.2.17 Initial Investment

Table 5.17 Initial Investment in Lakhs and Adoption of Innovation

Initial Investment in Lakhs	Adoption of Innovation			Total	KW Test		
	Open Innovation	Closed Innovation	Both		Chi-Square	df	Sig
Less Than 25	32	14	50	96	2.416	2	0.299
26-50	9	5	17	31			
51-75	8	1	4	13			
76-100	3	1	12	16			
Above 100	13	7	37	57			
Total	65	28	120	213			

Source: Survey Output

Table 5.17 describes the initial made by the SMEs and their adoption of innovation approach. 45.07% have made an investment of fewer than 25 lakhs, 14.55% have made an investment of 26-50 lakhs, 6.10% have made an investment of 51-75 Lakhs, 7.51%

have made an investment of 76-100 lakhs, and 26.76% have made an investment of above l00 lakhs.

From the KW test, it is clear that there is no difference in adoption of innovation among the SME groups based on the investment made.

5.2.18 Market served by SMEs

Table 5.18 Markets Served and Adoption of Innovation

Markets Served	Adoption of Innovation			Total	KW Test		
	Open Innovation	Closed Innovation	Both		Chi-Square	df	Sig
Domestic Only	19	7	41	67	0.941	2	0.625
Global Only	10	2	8	20			
Both	36	19	71	126			
Total	65	28	120	213			

Source: Survey Output

Table 5.18 describes the market served by the SMEs and their adoption of innovation.

31.46% of SMEs are serving only domestic markets, and among them, 28.35%, 10.45%, and 61.19% have adopted an open innovation, closed innovation and both the approaches respectively. 9.39% of SMEs are serving Global markets only, and among them, 50%, 10%, and 40% have adopted an open innovation, closed innovation and both approaches respectively. 59.15% of SMEs serve both domestic and global markets. Among them, 28.57% have adopted an open innovation, 15.07% have adopted a closed innovation, and 56.35% have adopted both the innovation approach.

From the KW test, it is clear that there is no difference in adoption of innovation among the SME groups based on the investment made.

5.2.19 Research & Development investment

Table 5.19 R&D Investment and Adoption of Innovation

R&D Investment in %	Adoption of Innovation			Total	KW Test		
	Open Innovation	Closed Innovation	Both		Chi-Square	df	Sig
0-10	18	7	29	54	0.235	2	0.889
11-20	16	6	31	53			
21-30	8	6	27	41			
31-50	18	4	21	43			
Above 50	5	5	12	22			
Total	65	28	120	213			

Source: Survey Output

Table 5.19 describes the investment in Research and Development made by SMEs. 25.35% of the SMEs respondents make an investment of 0-10%. Among them, 33.33% has adopted an open innovation, 12.96% have adopted a closed innovation, and 53.70% have adopted both approaches. 24.88% of SMEs respondent invest about 11-20 % on R&D. Among them, 30.19%, 11.32%, and 58.49% adopt an open innovation, closed innovation and both the approaches respectively.19.25% of SMEs respondents make an investment of 21-30% of their annual budget. Among them, 19.51%, 14.63%, and 65.85% have adopted an open innovation, closed innovation and both the approaches respectively. 20.19% of the respondent SMEs invest their R&D of about 31-50% of their annual budget. Among them, 41.86%, 9.30%, and 48.83% have adopted an open innovation, closed innovation and both the approaches respectively. 10.33% of the respondent SMEs invest more 50% of their R&D activities. Among them, 22.73%, 22.73%, and 54.54% have adopted an open innovation, closed innovation and both the approaches.

From the KW test, it is clear that there is no difference in adoption of innovation among the SME groups based on the investment made in Research and Development activity.

5.2.20 Intellectual Property Ownership

Table 5.20 IPR Ownership and Adoption of Innovation

IPR Ownership	Adoption of Innovation			Total	KW Test		
	Open Innovation	Closed Innovation	Both		Chi-Square	df	Sig
Yes	24	15	70	109	7.773	2	.021
No	41	13	50	104			
Total	65	28	120	213			

Source: Survey Output

Table 5.20 describes the adoption of innovation practices with respect to IPR ownership pattern. 51.17% of the SMEs own an IPR from its research and development. Among them, 22.01% adopt an open innovation, 13.76% adopt closed innovation and 64.22%adopt both the approaches. 48.83% of the SMEs do not own an IPR from its research and development. Among them, 39.42% have adopted an open innovation, 12.5% have adopted closed innovation and 48.08% adopt both the approaches.

From the KW test, it is clear that there is the difference in adoption of innovation among the SME groups based on ownership of IPR.

5.2.21 Factors motivating adoption of innovation

Table 5.21 Motivation for Innovation Adoption

Sl.No	Motivation for Innovation Adoption	Total
1	To be Market Leader	75
2	To satisfy Customer	61
3	Competition	6
4	Government Policies	0
5	All the four	59
6	Others	12
Total		213

Source: Survey Output

Table 5.21 describes the factors that motivate the SMEs to adopt an innovation. 35.21% of the respondents opine that to be a market leader is the motivates them to adopt innovation.28.63% feel that customer satisfaction is a motivation factor, 2.8% feel that competition motivates them, 27.69% feel that to be the market leader, customer satisfaction and competition together motivates them to adopt an innovation. But 5.6% of the respondents feel that some other factors such as passion for product development, quick problem solving motivate them to adopt an innovation.

5.2.22 Challenges for Innovation adoption

Table 5.22 Challenges for Innovation Adoption

Sl.No	Challenges for Innovation Adoption	Total
1	Employee Resistance	4
2	Non Co-operation among decision maker	6
3	Time Factor	111
4	All the three	22
5	No Challenges	25
6	Others	45
Total		213

Source: Survey Output

Table 5.22 outlines the challenges that are faced by SMEs in adopting an innovation. 52.11% respondents feel that time is the biggest challenge in adopting and practicing innovation across the firm. 1.88% of the respondent feel that employee resistance is one more challenge, 2.82% feel that non-co-operation from other decision maker is also a challenge, and 10.33% feel employee resistance, non-co-operation from decision maker and time factor are the challenges. 21.27% feel that none of these are challenges but other factors such as funds, resources, and cost are few challenges to adopting an innovation. 11.74% feel there are no challenges to adopting an innovation.

5.2.23 Open Innovation practices adopted

Table 5.23 OI practices adopted

OI Practices	Frequency	Percentage
Collaboration	40	18.8
IP in	3	1.4
IP out	1	0.5
Alliances	10	4.7
Spin-Off	1	0.5
All of These	33	15.5
None of These	27	12.7
Collaborations, Alliances	40	18.8
Collaborations, IP In, Alliances	14	6.6
Collaborations,IP out	4	1.9
Collaboration, IP in, IP out, Alliances	7	3.3
Collaboration, Alliances, Spin-off	13	6.1
Collaboration, IP Out, Alliances	2	0.9
Collaboration, IP in, IP out, Spin-Off	1	0.5
Collaboration, IP out, Spin-Off	2	0.9
IP in, IP out, Alliances	2	0.9
Collaboration, IP in	2	0.9
Collaboration, IP in, Alliances, Spin- off	1	0.5
IP out, Alliances,	2	0.9
Alliances, Spin -off	1	0.5
Collaboration, IP in, IP out	2	0.9
Collaboration, IP out, Spin-off	1	0.5
IP-In and Alliances	1	0.5
Collaboration, IP-out, Alliance, spin-off	1	0.5
Collaboration and Spin-off	2	0.9

Source: Survey Output

The table 5.23 provides the details of the open innovation practices adopted by the software product SMEs. From the table, it can be inferred that collaboration is the most practiced open innovation approach. Spin-off and Intellectual Property licensing out are the least practiced open innovation approach. But SMEs prefer to adopt a combination of these approaches.

5.3 Sample adequacy

The table 5.24 provides the details of the KMO-Bartlett's test. From the table, it can be seen that the KMO value is greater than 0.6 and p-value for Bartlett's test of sphericity is 0.000. Thus it is inferred that the sample size considered for the study is adequate.

Table 5.24 KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.700
Bartlett's Test of Sphericity	Approx. Chi-Square	3688.405
	df	1128
	Sig.	0.000

Source: Survey output

5.4 Awareness and Adoption of Innovation among SMEs

SMEs have an awareness of innovation practices such as open innovation practices and closed innovation practices. Also, these SMEs have adopted these practices of innovation. In order to test the association between awareness of innovation approach and its adoption, following hypothesis is stated.

H_{01}: There is a no significant positive association between awareness and adoption of Innovation approaches.

$H_{A1:}$ There is a significant positive association between awareness and adoption of Innovation approaches.

Table 5.25 Awareness of Innovation and Adoption of Innovation

Awareness of Innovation	Adoption of Innovation			Total
	Open Innovation	Closed Innovation	Both	
Open Innovation	41	1	2	44
Closed Innovation	1	4	0	5
Both	23	23	118	164
Total	65	28	120	213

Source: Survey Output

Table 5.25 provides the bivariate analysis of the awareness of innovation approaches among SMEs and its adoption by the SMEs. From the table, it can be inferred that 98.5%SMEs have adopted the innovation approach which they are aware of. Further it is observed that 93.18% of SMEs who are aware of open innovation only have adopted open innovation practices, 2.27% of the SMEs said to have adopted closed innovation practices even though they have indicated that they are aware of only open innovation practices and 4.54% have adopted both the approaches even though they are aware of only open innovation. Among the SMEs which are aware of only closed innovation

approach, 80% of SMEs have adopted a closed innovation, and 20% have said to have adopted open innovation approach. Among the SMEs who are aware of both the approaches, 14.02% have adopted open innovation approach, 14.02% have adopted closed innovation approach, and the remaining 71.95% have adopted both the innovation approaches.

Table 5.26 Results of Chi-Square Test

	Value	df	Sig. (2-sided)
Pearson Chi-Square	123.335	4	.000
Likelihood Ratio	116.502	4	.000
Linear-by-Linear Association	93.820	1	.000

Source: Survey Output

Table 5.26 provides the insight towards the Chi-Square test results. From the table, it is clear that the p-value is significant at 99.99% level of significance. This indicates that the alternate hypothesis i.e. H_{A1} is not rejected. This means there is a strong association among the SMEs with respect to awareness of innovation approach and its adoption.

5.5 Summary

The chapter describes the respondent's profiles with respect to age, gender, marital status, designation, education and work experience. Further, the SME profile is described with respect to age, size, the investment made, funding pattern, year of establishment, markets served, firm type based product, firm ownership, IPR ownership and investment in research and development. Also, the factors that motivate the SMEs to adopt innovation and challenges faced by the SMEs in adopting an innovation are identified. The Kruskal-Wallis test indicates that SME groups differ in the adoption of innovation practices only for the characteristics of the firm with respect age and IPR ownership. For the all other firm characteristics, they do not differ in the adoption of innovation. The sample size considered four the study is found to be adequate. Also, there is a positive association

with the firm for the awareness of innovation approach and its adoption. KW statistics in most cases are 0.10. This suggests the degree of differentiation of attributes. However, the degree of association are extracted with respect to firms.

Chapter 6

Factors Influencing Adoption of Innovation Approach

6.1 Introduction

This chapter examines the factors that may influence the SMEs to adopt open innovation approach, closed innovation approach or both. The factors may be internal to the firm or external to the firm or combination of both internal and external. Hence the study proposes the following hypothesis to examine the factors influencing the adoption of innovation.

H_{02a}: There is no significant influence of internal factors of the firm to adopt Innovation approach

H_{A2a}: There is a significant influence of internal factors of the firm to adopt Innovation approach

H_{02b}: There is no significant influence of external factors of the firm to adopt Innovation approach

H_{A2b}: There is a significant influence of external factors of the firm to adopt Innovation approach

H_{02c}: Adoption of Innovation is significantly not influenced by Internal and external factors of the firm

H_{A2c}: Adoption of Innovation is significantly influenced by Internal and external factors of the firm

6.2 Firm-level factors and Adoption of Innovation approach.

SMEs can adopt open innovation (OI) approach, closed innovation (CI) approach or both open innovation and closed innovation. The firm-level factors which are also labeled as internal factors of the firm which influences the firm to adopt innovation approach is the independent variable of the study. The adoption of innovation approach is the dependent variable, and the external factors of the firm are the covariates or control variable. The independent variables which may influences the SMEs to adopt innovation approach are Age of the firm(IF1), Size of the firm(IF2), Education of the decision maker(IF3), experience of the decision maker(IF4), culture of the firm(IFC1 to IFC8), emphasis on R&D(IF5) and investment in R &D(iF6). The covariates are competition (EF1), the customer (EF2), ecosystem (EF3), government policies (EF4) and technological advances (EF5). A multinomial logistic regression is carried out to find the influence of internal factors of the SMEs to adopt innovation approach. A multinomial regression equation is estimated to check the influence of an independent variable on the dependent variable.

The result of the multinomial regression is given below and is analyzed in three parts namely, model fit information, likelihood ratios, and parameter estimates. The absence of multicollinearity is normally tested by making correlation matrix of the independent variable and tested for significance. In all cases r values were found to be not statistically significant.

Table 6.1 Model Fitting Information for internal factors

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	405.639			
Final	214.445	191.194	112	.000

Source: Survey output

Table 6.2 Pseudo R-Square for internal factors

Pseudo R-Square Method	Pseudo R-Square Value
Cox and Snell	0.592
Nagelkerke	0.696
McFadden	0.471

Source: Survey output

Table 6.3 Likelihood Ratio Tests of internal factors

Effect	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	214.445[a]	.000	0	.
EF1	224.998	10.553	2	.005
EF2	224.202	9.757	2	.008
EF3	223.368	8.923	2	.012
EF4	216.195	1.750	2	.417
EF5	217.429	2.984	2	.225
IF1	240.537	26.092	8	.001
IF2	245.692	31.247	8	.000
IF3	237.577	23.132	8	.003
IF4	239.316	24.871	8	.002
IF5	228.789	14.344	6	.026
IF6	229.379	14.934	8	.060
IFC1	234.903	20.458	8	.009

IFC2	222.587	8.142	8	.420
IFC3	251.652	37.207	8	.000
IFC4	218.447	4.002	4	.406
IFC5	220.168	5.723	4	.221
IFC6	244.075	29.630	8	.000
IFC7	233.616	19.171	8	.014
IFC8	236.003	21.558	8	.006

Source: Survey output

Table 6.4 Internal Factors influencing adoption of Innovation

Adoption of Innovation		B	Std. Error	Wald	df	Sig.	Exp(B)
Open Innovation	Intercept	-2.606	2.896	.810	1	.368	
	EF1	-.519	.238	4.752	1	.029	.595
	EF2	.338	.344	.963	1	.326	1.402
	EF3	.851	.342	6.174	1	.013	2.342
	EF4	-.223	.212	1.104	1	.293	.800
	EF5	.216	.338	.410	1	.522	1.242
	IF1=1	-2.424	1.035	5.488	1	.019	.089
	IF1=2	-2.042	1.071	3.640	1	.056	.130
	IF1=3	-2.668	1.033	6.675	1	.010	.069
	IF1=4	-3.158	1.043	9.161	1	.002	.043
	IF1=5	0	.	.	0	.	.
	IF2=1	-.223	.985	.051	1	.821	.800
	IF2=2	-.722	.955	.571	1	.450	.486

	IF2=3	-.908	.904	1.008	1	.315	.403
	IF2=4	-2.356	.966	5.950	1	.015	.095
	IF2=5	0	.	.	0	.	.
	IF3=1	.224	.960	.055	1	.815	1.251
	IF3=2	.362	.891	.165	1	.684	1.437
	IF3=3	-1.901	1.073	3.141	1	.076	.149
	IF3=4	-.467	.953	.240	1	.624	.627
	IF3=5	0	.	.	0	.	.
	IF4=1	-1.872	1.644	1.296	1	.255	.154
	IF4=2	1.060	.972	1.190	1	.275	2.886
	IF4=3	.358	.832	.185	1	.667	1.431
	IF4=4	1.422	.695	4.187	1	.041	4.146
	IF4=5	0	.	.	0	.	.
	IF5=2	-.089	1.495	.004	1	.953	.915
	IF5=3	1.018	.879	1.340	1	.247	2.767
	IF5=4	-.319	.806	.156	1	.693	.727
	IF5=5	0	.	.	0	.	.
	IF6=1	25.262	6585.928	.000	1	.997	93529171462.257
	IF6=2	-.507	1.219	.173	1	.677	.602
	IF6=3	-.729	.945	.596	1	.440	.482
	IF6=4	-.355	.785	.204	1	.652	.702
	IF6=5	0	.	.	0	.	.
	IFC1=1	.332	1.703	.038	1	.846	1.393
	IFC1=2	.345	1.732	.040	1	.842	1.412
	IFC1=3	.955	1.916	.249	1	.618	2.600
	IFC1=4	4.427	2.162	4.191	1	.041	83.660
	IFC1=5	0	.	.	0	.	.

	IFC2=1	.119	1.133	.011	1	.916	1.127
	IFC2=2	.867	1.088	.635	1	.425	2.379
	IFC2=3	1.452	1.205	1.452	1	.228	4.273
	IFC2=4	.591	1.403	.177	1	.674	1.805
	IFC2=5	0	.	.	0	.	.
	IFC3=1	-.214	1.971	.012	1	.913	.807
	IFC3=2	2.990	1.392	4.617	1	.032	19.895
	IFC3=3	-.272	.938	.084	1	.772	.762
	IFC3=4	-.087	.648	.018	1	.893	.916
	IFC3=5	0	.	.	0	.	.
	IFC4=3	-1.388	1.737	.638	1	.424	.250
	IFC4=4	.427	.831	.264	1	.607	1.533
	IFC4=5	0	.	.	0	.	.
	IFC5=3	.157	2.282	.005	1	.945	1.170
	IFC5=4	-.850	.923	.848	1	.357	.428
	IFC5=5	0	.	.	0	.	.
	IFC6=1	-15.293	6585.713	.000	1	.998	2.281E-007
	IFC6=2	4.105	1.671	6.033	1	.014	60.628
	IFC6=3	1.978	.983	4.049	1	.044	7.226
	IFC6=4	.150	.728	.042	1	.837	1.162
	IFC6=5	0	.	.	0	.	.
	IFC7=1	1.916	1.445	1.759	1	.185	6.793
	IFC7=2	3.024	2.975	1.033	1	.309	20.571
	IFC7=3	4.022	1.519	7.011	1	.008	55.840
	IFC7=4	.145	.723	.040	1	.841	1.156
	IFC7=5	0	.	.	0	.	.
	IFC8=1	-2.848	1.444	3.886	1	.049	.058
	IFC8=2	2.461	1.565	2.473	1	.116	11.716

	IFC8=3	-.291	2.008	.021	1	.885	.747
	IFC8=4	-.941	.740	1.618	1	.203	.390
	IFC8=5	0	.	.	0	.	.
Closed Innovation	Intercept	-11.022	7.789	2.002	1	.157	
	EF1	-1.155	.457	6.403	1	.011	.315
	EF2	-2.095	.964	4.717	1	.030	.123
	EF3	1.307	.829	2.486	1	.115	3.695
	EF4	.267	.475	.317	1	.574	1.307
	EF5	1.484	.987	2.262	1	.133	4.409
	IF1=1	2.365	2.463	.922	1	.337	10.644
	IF1=2	-.280	2.492	.013	1	.910	.756
	IF1=3	-3.062	2.040	2.254	1	.133	.047
	IF1=4	-7.525	2.865	6.898	1	.009	.001
	IF1=5	0	.	.	0	.	.
	IF2=1	-1.079	2.202	.240	1	.624	.340
	IF2=2	-6.455	2.924	4.875	1	.027	.002
	IF2=3	2.369	1.705	1.931	1	.165	10.690
	IF2=4	-.050	2.203	.001	1	.982	.952
	IF2=5	0	.	.	0	.	.
	IF3=1	-3.486	2.669	1.706	1	.192	.031
	IF3=2	1.246	1.882	.438	1	.508	3.477
	IF3=3	-2.335	1.837	1.615	1	.204	.097
	IF3=4	5.506	2.566	4.604	1	.032	246.237
	IF3=5	0	.	.	0	.	.
	IF4=1	-22.937	2026.786	.000	1	.991	1.093E-010
	IF4=2	1.430	1.834	.608	1	.435	4.179
	IF4=3	-7.670	2.974	6.649	1	.010	.000
	IF4=4	-2.635	1.685	2.443	1	.118	.072

	IF4=5	0	.	.	0	.	.
	IF5=2	-10.747	5.654	3.613	1	.057	2.151E-005
	IF5=3	-4.379	2.503	3.062	1	.080	.013
	IF5=4	.454	1.568	.084	1	.772	1.575
	IF5=5	0	.	.	0	.	.
	IF6=1	28.714	.000	.	1	.	2954000449074.987
	IF6=2	4.771	3.688	1.673	1	.196	117.980
	IF6=3	5.624	3.058	3.383	1	.066	277.019
	IF6=4	2.866	2.102	1.858	1	.173	17.558
	IF6=5	0	.	.	0	.	.
	IFC1=1	-1.592	3.162	.253	1	.615	.204
	IFC1=2	-5.680	3.564	2.539	1	.111	.003
	IFC1=3	-6.546	3.823	2.931	1	.087	.001
	IFC1=4	-4.786	4.664	1.053	1	.305	.008
	IFC1=5	0	.	.	0	.	.
	IFC2=1	6.290	3.442	3.339	1	.068	539.014
	IFC2=2	5.129	3.175	2.610	1	.106	168.786
	IFC2=3	5.541	3.234	2.935	1	.087	254.832
	IFC2=4	6.142	3.852	2.543	1	.111	465.085
	IFC2=5	0	.	.	0	.	.
	IFC3=1	20.067	6.949	8.338	1	.004	518659992.774
	IFC3=2	14.316	4.978	8.270	1	.004	1649796.373
	IFC3=3	7.040	2.944	5.718	1	.017	1141.373
	IFC3=4	3.681	2.013	3.345	1	.067	39.704
	IFC3=5	0	.	.	0	.	.
	IFC4=3	-19.943	1780.726	.000	1	.991	2.181E-009

	IFC4=4	-3.291	2.568	1.642	1	.200	.037
	IFC4=5	0	.	.	0	.	.
	IFC5=3	-20.434	2368.165	.000	1	.993	1.336E-009
	IFC5=4	2.604	2.399	1.179	1	.278	13.522
	IFC5=5	0	.	.	0	.	.
	IFC6=1	-7.227	.000	.	1	.	.001
	IFC6=2	-15.452	2992.314	.000	1	.996	1.946E-007
	IFC6=3	10.602	3.546	8.939	1	.003	40227.430
	IFC6=4	4.476	1.749	6.549	1	.010	87.846
	IFC6=5	0	.	.	0	.	.
	IFC7=1	-8.452	4.976	2.885	1	.089	.000
	IFC7=2	-18.419	3691.969	.000	1	.996	1.002E-008
	IFC7=3	.167	2.888	.003	1	.954	1.182
	IFC7=4	1.009	1.696	.354	1	.552	2.743
	IFC7=5	0	.	.	0	.	.
	IFC8=1	6.392	3.270	3.822	1	.051	597.240
	IFC8=2	4.287	2.505	2.929	1	.087	72.763
	IFC8=3	4.918	3.678	1.788	1	.181	136.701
	IFC8=4	2.310	1.284	3.234	1	.072	10.070
	IFC8=5	0	.	.	0	.	.

Source: Survey output

The table provides the information of the model fit. From the table, it can be said that model is fit at 99% significance level. The goodness of fit is not tested, here only model fit is assessed. This indicates that the null hypothesis i.e. H_{01} is not accepted. This means that the firm level factors or the internal factors of the firm have a significant influence on the adoption of innovation. The extent to which these factors influence to adopt Open Innovation and Closed Innovation compared to both the approaches is given the

parameter estimates. The Nagelkerke explains more variance among the variables as compared to Cox and shell, McFadden. The explanation for variance is about 69.6%.

From the likelihood ratio table, the internal factors that may likely influence the firm to adopt innovation can be found. From the table, it is clear that firm-level factors such as firm age, firm size, Education of the entrepreneur, experience of the entrepreneur, Emphasis of R&D activities, R & D investment and certain cultural factors of the firm may likely influence the firm to adopt the innovation approach. The moderating factors i.e. competition, customers, and ecosystem may likely influence to the independent variables to adopt an innovation.

6.2.1 Firm Level Factors influencing adoption of Open Innovation as compared to both the approaches.

6.2.1.1 Age of the firm

The results indicate that the age is the firm is one of the factors that influence the firm to adopt innovation and is significant statistically and negative. The firms strongly disagreement level decreases significantly compared to the firms strongly agreement level, disagreement level decreases significantly compared to the strongly agreement level, neutrality decreases significantly compared to the strongly agreement level, and agreement level decreases significantly compared to the strongly agreement level among the SME to adopt open innovation as compared to both approaches. This indicates as the age of the firm increases the adoption of open innovation compared to both innovation approaches decreases. Hence it can be said that newer firms likely to adopt open innovation as compared to both the approaches then the older firms.

6.2.1.2 Size of the firm

The result indicates that size of the significantly influences the firm in adopting open innovation compared to both approaches. The significance is negative. This indicates that the agreement decreases with respect to strongly agree in the adoption of open innovation compared to both the approaches among the respondents. This indicates that as the adoption of Open innovation compared to the adoption of both practices decreases as the size of the firm increases.

6.2.1.3 Education of the decision maker

The result indicates that education level of the decision maker is negatively significant. The result further indicates that the neutrality in the response decreases as compared to strongly agree. This means that the education level of the decision makers is more likely to influence adoption of open innovation as compared to both the approaches of innovation.

6.2.1.4 Experience of the entrepreneur

The result indicates that entrepreneur's experience is significant. The significance is positive. The result indicates that the agreement increases as compared to strongly agreement in the adoption of open innovation as compared to both the innovation approaches. This means the experience of the entrepreneur will influence the adoption of open innovation compared to both the approaches increases.

6.2.1.5 Cultural Factor 1: Innovation practices are perceived as too risky in our firm

The result indicates that this factor of cultural is significant statistically. The significance is positive. The result indicates that the agreement increases as compared to a strongly agreement in the adoption of open innovation as compared to both the innovation approaches. Hence it can be said that SMEs who perceive that innovation practices as risky are more likely to adopt open innovation as compared to both the approaches.

6.2.1.6 Cultural Factor 2: In our firm, we seek innovative ideas from our internal sources only

The result indicates that this factor of cultural is not significant statistically. Hence it can be said SMEs with a culture that seeks innovative ideas from our internal sources alone do not influence to adopt an innovation.

6.2.1.7 Cultural Factor 3: In our firm, we are keen on sourcing ideas from external sources also

The result indicates that the factor of cultural is significant. This indicates that SMEs who are keen on sourcing ideas from external sources is also a key cultural factor for innovation. But the results indicate that the disagreement increases as compared to strongly agree to adopt open innovation as compared to both approaches. So it can be inferred that sourcing of ideas from external sources will be most likely to decrease the adoption of open innovation as compared to both approaches.

6.2.1.8 Cultural Factor 4: We promote innovative ideas in our firm

The result indicates that this factor of cultural is not significant statistically. This shows that for the adoption of innovation, this factor most likely may not be influencing.

6.2.1.9 Cultural factor 5: We support innovative ideas in our firm

The result indicates that this factor of cultural is not significant statistically. This shows that for the adoption of innovation, this factor most likely may not be influencing.

6.2.1.10 Cultural factor 6: In our firm, Employees are rewarded for proposing new ideas

The result indicates that this factor of cultural is significant. The significance is positive for at the location 2 and location 3 of the scale. This indicates that SMEs who have a culture of rewarding employees for proposing new idea significantly influences the

adoption of open innovation compared to both the approaches. But the results indicate that the disagreement increases as compared to strongly agree and neutrality level increases as compared to strongly agree. So it can be inferred that SMEs having a culture of rewarding employees for proposing new ideas will be most likely to decrease the adoption of open innovation compared to the adoption of both approaches.

6.2.1.11 Cultural factor 7: In our firm, Employees are not hesitant to speak about new idea for better performance

The result indicates that this factor of culture is significant. The significance is positive at location 3. This means that the neutrality of the response increases compared to the strongly agreement. The results also show that SMEs feel that they are still not clear whether employees are really expressive in coming out with the new idea during the discussion for better performance. Thus it can be said that this that SMEs are having a culture where employees are not hesitant to speak about new idea may most likely influence to adopt open innovation than both approaches.

6.2.1.12 Cultural factor 8: In our firm, Employees are not penalized if the new ideas proposed do not work

The result indicates that this factor of culture is significant to adopt an innovation. The significance is negative at location 1 of the scale. This indicates that the strongly disagreement decreases as compared to a strongly agreement. This means the SMEs who have a culture of not penalizing the employees if their proposed idea does not produce results are most likely to adopt open innovation as compared to both the approach.

6.2.1.13 Emphasis on Research and Development

The result indicates that emphasis on research and development is not a significant factor in adopting innovation since the results are statistically insignificant. Hence it does not influence to adopt open innovation as compared to both approaches

6.2.1.14 Investment in Research and Development

The result indicates that investment in research and development among SMEs is not a significant factor in adopting innovation since the results are statistically insignificant. Hence it does not influence to adopt open innovation as compared to both approaches

6.2.2 Factors influencing adoption of Closed Innovation as compared to both the approaches.

6.2.2.1 Age of the firm

The results indicate that the age of the firm is significant statistically and is negative. The results are significant for the location 4. The firm's agreement level decreases compared to the strongly agreement level to adopt closed innovation compared to both. This indicates that as the age of the firm increases their adoption of closed innovation compared to both the approaches decreases.

6.2.2.2 Size of the firm

The result indicates that size of the firm is significant statistically. The significance is negative at location 2. This means disagreement decreases compared to strongly agree to adopt to closed innovation compared to both approaches. This indicates that as the adoption of closed innovation compared to the adoption of both practices decreases as the size of the firm increases.

6.2.2.3 Education of the decision maker

The result indicates that education level of the decision maker is significant positively. The agreement level increases compared to strongly agree to adopt closed innovation as compared to both the approaches. This means that the education level of the decision makers is more likely to influence adoption of closed innovation as compared to both the approaches of innovation.

6.2.2.4 Experience of the entrepreneur

The result indicates that experience of the entrepreneur is significant. The significance is negative. The negative significance at location 3 indicates that the neutrality decreases as compared to strongly agreement level in the adoption of closed innovation as compared to both the innovation approaches. This means the experience of the entrepreneur is likely to influence the adoption of closed innovation compared to both the approaches increases.

6.2.2.5 Cultural Factor 1: Innovation practices are perceived as too risky in our firm

The result indicates that this factor of cultural is significant statistically. The significance is negative at location 3 of the scale. This indicates that SMEs neutrality decreases compared to strongly agree. Hence it can be said that SMEs who perceive that innovation practices as risky are more likely to adopt closed innovation approach compared to both approaches.

6.2.2.6 Cultural Factor 2: In our firm, we seek innovative ideas from our internal sources only

The result indicates that this factor of cultural is positively significant statistically at locations 1 and 3. This indicates that strongly disagreement increases compared to strongly agree and neutrality increases compared to strongly agree to adopt closed innovation compared both approaches. Hence it can be said SMEs with a culture that seeks innovative ideas from our internal sources alone have a less influence to adopt closed innovation compared to both approaches.

6.2.2.7 Cultural Factor 3: In our firm, we are keen on sourcing ideas from external sources also

The result indicates that the factor of cultural is significant. The significance is positive at location 1, 2, 3 and 4 of the scale. The results indicate that the strongly disagreement

increases as compared to strongly agree, disagreement increases as compared to strongly agree, neutrality increases as compared to strongly agree and agree increases compared to strongly agree .This indicates that SMEs who are keen on sourcing ideas from external sources are not sure that this will influence to adopt closed innovation compared to both approaches.

6.2.2.8 Cultural Factor 4: We promote innovative ideas in our firm

The result indicates that this factor of cultural is not significant statistically. This shows that for the adoption of innovation, this factor most likely may not be influencing.

6.2.2.9 Cultural factor 5: We support innovative ideas in our firm

The result indicates that this factor of cultural is not significant statistically. This shows that for the adoption of innovation, this factor most likely may not be influencing.

6.2.2.10 Cultural factor 6: In our firm, Employees are rewarded for proposing new ideas

The result indicates that this factor of cultural is significant. The significance is positive at the location 3 and 4 of the scale. This result indicates that the neutrality and agreement increase as compared to strongly agree. This means that SMEs who have a culture of rewarding employees for proposing new idea significantly influences the adoption of closed innovation compared to both approaches. So it can be said SMEs are having a culture of rewarding employees for proposing new ideas will be most likely to increase the adoption of closed innovation approach compared to both approaches.

6.2.2.11 Cultural factor 7: In our firm, Employees are not hesitant to speak about new idea for better performance

The result indicates that this factor of culture is significant. The significance is negative at location 1. This means that the strongly disagreement decreases compared to the strongly agreement to adopt closed innovation compared to both approaches. This

indicates that SMES who have a culture wherein employees are not hesitant to speak about a new idea for better performance are most likely to influence to adopt closed innovation approach compared to both approaches.

6.2.2.12 Cultural factor 8: In our firm, Employees are not penalized if the new ideas proposed do not work

The result indicates that this factor of culture is significant to adopt an innovation. The significance is positive at location 1, 2 and 4 of the scale. This indicates that the Strongly disagreement increases as compared to strongly agreement, disagreement increases as compared to strongly agreement and agreement also increases compared to strongly agreement. This means the SMEs who have a culture of not penalizing employees if their proposed ideas do not work are inconclusive about this factor being influencing to adopt closed innovation compared to both approaches.

6.2.2.13 Emphasis on Research and Development

The result indicates that emphasis on research and development is significant negatively. This significance is negative at location 2 and 3. This indicates the disagreement decreases compared to strongly agree and neutrality decreases compared to strongly agree respectively to adopt closed innovation compared to both approaches. This means SMEs who emphasis on R &D is more to likely influence to adopt closed innovation compared to both approaches.

6.2.2.14 Investment in Research and Development

The result indicates that investment in research and development among SMEs is a significant factor in adopting closed innovation compared to both approaches. The results are significant positively at location 3. This indicates that the neutrality increases as compared to strongly agree. This means investment in Research and Development most likely to influence to adopt closed innovation compared to both approaches.

6.2.3 Effect of control variables for adoption of innovation

The control variables also play a prominent role. In the case of adoption of open innovation compared to both approaches, the control variables competition and ecosystem play an important role in influencing the independent variables. In the case of adoption of closed innovation compared to the approaches, competition and customer catalysis the independent variables.

6.2.4 Inferences

The result shows that age of the firm negatively influences the adoption of open innovation and closed innovation independently compared to the adoption of both the approaches. This indicates that as the age of the firm increases firms prefer to adopt both the approaches. The results concur with the results of Mazzola et al. (2012) and Mina et al. (2014).

The results with respect to the size of firm and adoption of open innovation and closed innovation indicate that size of the firm negatively influences the adoption of open innovation and closed innovation independently compared to both approaches. This indicates that firm believes that as the size increases they prefer to adopt a combination of both open and closed innovation approach than open innovation or closed innovation in a silo. The results concur with the results of Mazzola et al. (2012) but differ with earlier researchers (Lichtenthaler, 2008; Gumus and Cubuku, 2011; Abulrub and Lee, 2012; and Mina et al., 2014).

The education qualification of the decision maker of SMEs significantly influences the adoption of innovation. The results agree with the study of Bayarcelik, Tasel, and Apak (2014) but their influence differs considerably. For adoption of the open approach, they influence negatively and for closed innovation positively.

The experience of decision maker significantly influences the adoption of innovation. For adoption of open approach they influence positively and for closed innovation negatively

The firm culture has an influence on adoption on open innovation and closed innovation independently. The results agree with the study of Roper (1997), Chen et al. (2008), Gumus and Cubukcu (2011), Mbizi et al.(2013), Bayarcelik, Tasel and Apak (2014).

The results indicate that investment in R & D in SMEs is not a significant influencing factor in adopting an open innovation. The results differ with the earlier studies (Chen and Chen, 2005; Yifeng, 2011; Bianchi et al., 2016) whereas the investment in R&D influences SMEs to adopt closed innovation. Hence it could be said that investment in R&D influences adoption of innovation (Ren et al., 2015; Chen and Chen, 2005; Yifeng, 2011; Bianchi et al. 2016).

6.3 External factors and Adoption of Innovation

SMEs can adopt open innovation approach, closed innovation approach or both open innovation and closed innovation. The External factors to the firm which influences the SMEs are competition (EF1), Customers (EF2), Eco System (EF3), Government Policies (EF4), and Technological Advances (EF5). The control variables are firm internal factors such as firm age, size, experience, education, cultural factors, emphasis on R & D and investment in R & D. A multinomial logistic regression is carried out to find the external factors that influence the SMEs to adopt innovation approach. A multinomial regression equation is estimated to check the influence of an independent variable on the dependent variable.

The result of the multinomial regression is given below and is analyzed in three parts namely, model fit information, likelihood ratios, and parameter estimates.

Table 6.5 Model Fitting Information for external factors

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	405.639			
Final	310.680	94.959	68	.017

Source: Survey Output

Table 6.6 Pseudo R-Square for external factors

Pseudo R-Square Method	Pseudo R-Square Value
Cox and Snell	0.360
Nagelkerke	0.423
McFadden	0.234

Source: Survey Output

Table 6.7 Likelihood Ratio Tests for external factors

Effect	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	310.680	.000	0	.
IF1	314.218	3.538	2	.170
IF2	313.852	3.172	2	.205
IF3	311.315	.636	2	.728
IF4	311.063	.383	2	.826
IFC1	315.430	4.750	2	.093
IFC2	315.121	4.441	2	.109
IFC3	325.249	14.569	2	.001
IFC4	310.881	.202	2	.904
IFC5	312.140	1.460	2	.482
IFC6	317.269	6.589	2	.037
IFC7	315.543	4.863	2	.088
IFC9	318.482	7.802	2	.020

IF5	316.065	5.385	2	.068
IF6	312.021	1.341	2	.511
EF1	328.023	17.343	8	.027
EF2	320.081	9.401	8	.310
EF3	327.018	16.338	8	.038
EF4	318.676	7.996	8	.434
EF5	319.457	8.777	8	.361

Source: Survey Output

Table 6.8 Estimates of External factors influencing Adoption of Innovation

Adoption of Innovation		B	Std. Error	Wald	df	Sig.	Exp(B)
Open Innovation	Intercept	-.028	2.452	.000	1	.991	
	IF1	.282	.157	3.232	1	.072	1.326
	IF2	-.277	.165	2.804	1	.094	.758
	IF3	-.105	.148	.501	1	.479	.900
	IF4	.005	.183	.001	1	.978	1.005
	IFC1	.403	.199	4.103	1	.043	1.496
	IFC2	-.032	.179	.033	1	.856	.968
	IFC3	-.224	.209	1.148	1	.284	.800
	IFC4	.075	.443	.029	1	.866	1.078
	IFC5	.565	.490	1.327	1	.249	1.759
	IFC6	-.328	.256	1.639	1	.200	.721
	IFC7	-.387	.208	3.473	1	.062	.679
	IFC9	.391	.218	3.224	1	.073	1.478

	IF5	-.358	.306	1.362	1	.243	.699
	IF6	.007	.261	.001	1	.977	1.007
	EF1=1	.079	1.421	.003	1	.956	1.082
	EF1=2	1.899	.817	5.395	1	.020	6.676
	EF1=3	.771	.568	1.841	1	.175	2.162
	EF1=4	.362	.500	.523	1	.469	1.436
	EF1=5	0	.	.	0	.	.
	EF2=1	-.501	.000	.	1	.	.606
	EF2=2	-1.243	1.232	1.018	1	.313	.289
	EF2=3	.472	.623	.574	1	.449	1.603
	EF2=4	.178	.441	.163	1	.687	1.195
	EF2=5	0	.	.	0	.	.
	EF3=1	-13.863	1026.426	.000	1	.989	9.539E-007
	EF3=2	-1.003	.846	1.406	1	.236	.367
	EF3=3	-1.419	.641	4.903	1	.027	.242
	EF3=4	-.692	.453	2.334	1	.127	.500
	EF3=5	0	.	.	0	.	.
	EF4=1	-.125	.677	.034	1	.854	.883
	EF4=2	-.044	.723	.004	1	.952	.957
	EF4=3	-.506	.663	.583	1	.445	.603
	EF4=4	-.459	.671	.468	1	.494	.632
	EF4=5	0	.	.	0	.	.
	EF5=1	-14.067	1469.472	.000	1	.992	7.775E-007
	EF5=2	-1.852	1.275	2.110	1	.146	.157
	EF5=3	.976	.771	1.604	1	.205	2.655
	EF5=4	.168	.447	.141	1	.708	1.183
	EF5=5	0	.	.	0	.	.
Closed	Intercept	4.718	4.263	1.225	1	.268	

Innovation	IF1	-.022	.276	.006	1	.937	.979
	IF2	.055	.269	.042	1	.838	1.056
	IF3	.058	.256	.051	1	.821	1.060
	IF4	-.170	.289	.347	1	.556	.843
	IFC1	.352	.310	1.292	1	.256	1.422
	IFC2	-.695	.351	3.916	1	.048	.499
	IFC3	-1.154	.325	12.610	1	.000	.315
	IFC4	.383	.881	.189	1	.664	1.467
	IFC5	-.069	.840	.007	1	.935	.933
	IFC6	-1.001	.416	5.792	1	.016	.368
	IFC7	.267	.365	.537	1	.464	1.306
	IFC9	-.476	.281	2.871	1	.090	.621
	IF5	.919	.556	2.731	1	.098	2.507
	IF6	-.495	.437	1.281	1	.258	.610
	EF1=1	2.549	1.355	3.541	1	.060	12.794
	EF1=2	1.802	1.258	2.053	1	.152	6.063
	EF1=3	.408	1.008	.164	1	.686	1.504
	EF1=4	-1.304	.761	2.935	1	.087	.271
	EF1=5	0	.	.	0	.	.
	EF2=1	20.849	7059.214	.000	1	.998	1133649257 .969
	EF2=2	.984	1.248	.621	1	.431	2.674
	EF2=3	-.524	1.016	.267	1	.606	.592
	EF2=4	-.189	.677	.078	1	.780	.828
	EF2=5	0	.	.	0	.	.
	EF3=1	-10.825	1470.333	.000	1	.994	1.990E-005
	EF3=2	-12.753	433.841	.001	1	.977	2.892E-006
	EF3=3	.836	1.007	.689	1	.406	2.307

	EF3=4	1.442	.764	3.567	1	.059	4.231
	EF3=5	0	.	.	0	.	.
	EF4=1	-.533	1.249	.182	1	.670	.587
	EF4=2	-.302	1.298	.054	1	.816	.739
	EF4=3	.904	1.099	.677	1	.411	2.470
	EF4=4	1.428	1.142	1.564	1	.211	4.169
	EF4=5	0	.	.	0	.	.
	EF5=1	-15.649	2238.921	.000	1	.994	1.598E-007
	EF5=2	-.216	1.551	.019	1	.889	.806
	EF5=3	-1.574	1.896	.689	1	.407	.207
	EF5=4	.312	.661	.222	1	.637	1.366
	EF5=5	0	.	.	0	.	.

Source: Survey Output

Table 6.5 provides the information on the model. The table 6.5 indicates that the model is statistically fit at 95 % and at 90%. Hence the null hypothesis i.e. H_{02} is rejected. This means there is an influence of external factors on the adoption of innovation. The Nagelkerke pseudo-R-square value explains the variance of 42.3%.

Table 6.7 provides the likelihood ratios. It is found that competition and ecosystem may likely influence the SMEs to adopt the innovation approach along with control variables such as cultural factors.

6.3.1 External factors influence to adopt Open Innovation compared to both the approaches.

Table 6.8 provides the estimates of the external factors and control variables that influence to adopt open innovation as compared to both approaches.

6.3.1.1 Competition

The result indicates that competition is a significant factor that influences the adoption of innovation. The result is statistically significant and is positive at the location 2. This indicates that the disagree increases as compared to strongly agree for the adoption of open innovation compared to both approaches. This means competition influences less to adopt open innovation compared to both approaches.

6.3.1.2 Customer

The results of multinomial regression indicate that customer does not influence the SMEs to adopt open innovation compared to both the approaches. The results of the test are statistically insignificant.

6.3.1.3 Ecosystem

The result indicates that ecosystem is a significant factor that influences the adoption of innovation. The result is statistically significant and is negative on the location 3. This indicates that the neutrality decreases as compared to strongly agree for the adoption of open innovation compared to both approaches. This means ecosystem influences SMEs to adopt open innovation more compared to both approaches.

6.3.1.4 Government Policies

The results of multinomial regression indicate that government policies do not influence the SMEs to adopt open innovation compared to both the approaches. The results of the test are statistically insignificant.

6.3.1.5 Technological Advances

The results of multinomial regression indicate that technological advances do not influence the SMEs to adopt open innovation compared to both the approaches. The results of the test are statistically insignificant.

6.3.2 External factors influence to adopt Closed Innovation compared to both the approaches.

6.3.2.1 Competition

The result indicates that competition is a significant factor that influences the adoption of innovation. The result is statistically significant, is positive on the location 1 and negative on location 4. This indicates that the strongly disagree increases as compared to strongly agree and agree decreases with for adoption of closed innovation compared to both approaches. This means competition influences less to adopt closed innovation compared to both approaches.

6.3.2.2 Customer

The results of multinomial regression indicate that customer does not influence the SMEs to adopt closed innovation compared to both the approaches. The results of the test are statistically insignificant.

6.3.2.3 Ecosystem

The result indicates that ecosystem is a significant factor that influences the adoption of innovation. The result is statistically significant and is positive at the location 4. This indicates that the agree increases as compared to strongly agree for the adoption of closed innovation compared to both approaches. This means ecosystem influences SMEs to adopt closed innovation more compared to both approaches.

6.3.2.4 Government Policies

The results of multinomial regression indicate that government policies do not influence the SMEs to adopt closed innovation compared to both the approaches. The results of the test are statistically insignificant.

6.3.2.5 Technological Advances

The results of multinomial regression indicate that technological advances do not influence the SMEs to adopt closed innovation compared to both the approaches. The results of the test are statistically insignificant.

6.3.3 Influence of control variables to adopt innovation

The control variables catalyze the independent variables to influence the dependent variable. The firm level factors such as firm age, size, and certain culture factors influence the independent variables to adopt open innovation as compared to closed innovation. For the adoption of closed innovation compared to both the approaches, firm level factors such as cultural factors and R & D emphasis catalyzes the independent variables to influence the dependent variables.

6.3.4 Inferences

The results indicate that external factors such as competition and ecosystem influence SMEs to adopt an innovation. Competition positively influences SMEs to adopt open innovation and adopt closed innovation whereas ecosystem negatively influences SMEs to adopt open innovation and positively to adopt closed innovation. These results concur with the results of Nicita et al. (2005) and Masson (2013). Whereas other external factors such as customers, government policies, and technological advancements do not significantly influence SMEs to adopt an innovation. These results are contradicting the results of earlier researchers (Ghafele and O'Brien, 2013; Wynarczyk, 2013; Hamdani and Wirawan, 2012; Gourova and Toteva, 2012; De Massis et al., 2011; Cooke and Wills, 1999; Krapex, Skerlavaj, and Groznik, 2012). Thus it can be said only

competition, and local ecosystem influences the SMEs in Indian Software Product segment to adopt an innovation.

6.4 Firm-Level and External factors influence on Adoption of Innovation

SMEs can adopt open innovation approach, closed innovation approach or both open innovation and closed innovation. The firm-level factors which are also labeled as internal factors of the firm which influences the SMEs are Age of the firm, Size of the firm, Education of the decision maker, the experience of the decision maker, the culture of the firm, emphasis on R&D and investment in R &D. The External factors to the firm which influences the SMEs are competition, Customers, Eco System, Government Policies, and Technological Advances. A multinomial logistic regression is carried out to find the influence of Firm-level factors and external factors to the SMEs to adopt an innovation approach. A multinomial regression equation is estimated to check the influence of an independent variable on the dependent variable.

The result of the multinomial regression is given below and is analyzed in three parts namely, model fit information, likelihood ratios and parameter estimates

Table 6.9 Model Fitting Information Both firm level and external factors

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	405.639			
Final	118.744	286.894	142	.000

Source: Survey Output

Table 6.10 Pseudo R-Square of Both firm level and external factors

Pseudo R-Square Method	Pseudo R-Square Value
Cox and Snell	0.740
Nagelkerke	0.869
McFadden	0.707

Source: Survey Output

Table 6.11 Likelihood Ratio Tests of both firm level and external factors

Effect	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	118.744	.000	0	.
Firm Age(IF1)	129.485	10.741	8	.217
Firm Size(IF2)	132.444	13.699	8	.090
Education(IF3)	134.363	15.619	8	.048
Experience(IF4)	130.291	11.547	8	.173
R&D Emphasis (IF5)	124.143	5.399	6	.494
R&D Invest (IF6)	130.995	12.250	8	.140
Cultural 1(IFC1)	132.269	13.525	8	.095
Cultural 2 (IFC2)	123.981	5.237	8	.732
Cultural 3(IFC3)	125.229	6.485	8	.593
Cultural 4(IFC4)	120.789	2.045	4	.727
Cultural 5(IFC5)	118.850	.106	4	.999
Cultural 6(IFC6)	131.474	12.730	8	.121
Cultural 7(IFC7)	129.029	10.284	8	.246
Cultural 8(IFC8)	128.645	9.900	8	.272
Competition(EF1)	126.829	8.084	8	.425
Customers (EF2)	124.184	5.440	8	.710

Eco System (EF3)	130.813	12.069	8	.148
Government Policies (EF4)	120.128	1.383	8	.994
Technological Advances (EF5)	131.071	12.327	8	.137

Source: Survey Output

Table 6.12 Parameter Estimates of Factors influencing Innovation

Adoption of Innovation		B	Std. Error	Wald	df	Sig.	Exp(B)
Open Innovation	Intercept	3.849	2.241	2.950	1	.086	
	IF1=1	-2.430	1.303	3.478	1	**.062**	.088
	IF1=2	-2.204	1.436	2.358	1	.125	.110
	IF1=3	-2.652	1.290	4.229	1	**.040**	.070
	IF1=4	-3.972	1.407	7.972	1	**.005**	.019
	IF1=5	0	.	.	0	.	.
	IF2=1	-1.763	1.394	1.601	1	.206	.171
	IF2=2	-2.067	1.410	2.147	1	.143	.127
	IF2=3	-1.795	1.309	1.880	1	.170	.166
	IF2=4	-4.408	1.517	8.441	1	**.004**	.012
	IF2=5	0	.	.	0	.	.
	IF3=1	.338	1.312	.066	1	.797	1.402
	IF3=2	-.279	1.238	.051	1	.821	.756
	IF3=3	-3.814	1.448	6.935	1	**.008**	.022
	IF3=4	-2.268	1.418	2.556	1	.110	.104
	IF3=5	0	.	.	0	.	.
	IF4=1	-4.021	2.210	3.309	1	**.069**	.018
	IF4=2	1.033	1.264	.669	1	.413	2.811

	IF4=3	.104	1.111	.009	1	.925	1.110
	IF4=4	2.532	1.092	5.375	1	**.020**	12.576
	IF4=5	0	.	.	0	.	.
	IF5=2	.566	2.122	.071	1	.790	1.761
	IF5=3	1.969	1.191	2.730	1	**.098**	7.161
	IF5=4	-.194	1.108	.031	1	.861	.824
	IF5=5	0	.	.	0	.	.
	IF6=1	25.475	1631.990	.000	1	.988	11581422332 7.678
	IF6=2	-1.000	1.690	.350	1	.554	.368
	IF6=3	-2.225	1.363	2.663	1	.103	.108
	IF6=4	-.903	1.069	.713	1	.398	.405
	IF6=5	0	.	.	0	.	.
	IFC1=1	-1.176	2.110	.310	1	.578	.309
	IFC1=2	-2.511	2.330	1.162	1	.281	.081
	IFC1=3	-.430	2.566	.028	1	.867	.650
	IFC1=4	4.363	2.683	2.644	1	.104	78.524
	IFC1=5	0	.	.	0	.	.
	IFC2=1	.135	1.586	.007	1	.932	1.144
	IFC2=2	1.783	1.573	1.285	1	.257	5.948
	IFC2=3	2.520	1.667	2.285	1	.131	12.427
	IFC2=4	2.244	1.767	1.612	1	.204	9.432
	IFC2=5	0	.	.	0	.	.
	IFC3=1	2.226	2.886	.595	1	.441	9.263
	IFC3=2	3.284	1.887	3.029	1	**.082**	26.678
	IFC3=3	-.204	1.284	.025	1	.874	.815
	IFC3=4	-.693	.949	.532	1	.466	.500
	IFC3=5	0	.	.	0	.	.

	IFC4=3	-2.728	1.940	1.976	1	.160	.065
	IFC4=4	-.670	1.043	.413	1	.520	.512
	IFC4=5	0	.	.	0	.	.
	IFC5=3	-.607	3.028	.040	1	.841	.545
	IFC5=4	-.345	1.235	.078	1	.780	.708
	IFC5=5	0	.	.	0	.	.
	IFC6=1	-12.405	1469.475	.000	1	.993	4.099E-006
	IFC6=2	3.888	2.163	3.232	1	**.072**	48.823
	IFC6=3	3.962	1.389	8.139	1	**.004**	52.577
	IFC6=4	.516	.973	.281	1	.596	1.675
	IFC6=5	0	.	.	0	.	.
	IFC7=1	2.780	2.185	1.618	1	.203	16.119
	IFC7=2	6.047	3.578	2.857	1	**.091**	423.017
	IFC7=3	3.745	1.881	3.963	1	**.047**	42.298
	IFC7=4	.155	.977	.025	1	.874	1.168
	IFC7=5	0	.	.	0	.	.
	IFC8=1	-3.894	1.886	4.262	1	**.039**	.020
	IFC8=2	2.835	2.243	1.598	1	.206	17.033
	IFC8=3	-.618	3.615	.029	1	.864	.539
	IFC8=4	-.559	.968	.334	1	.563	.572
	IFC8=5	0	.	.	0	.	.
	EF1=1	1.871	3.591	.272	1	.602	6.497
	EF1=2	2.795	1.537	3.306	1	**.069**	16.360
	EF1=3	2.357	1.135	4.311	1	**.038**	10.558
	EF1=4	-.155	.996	.024	1	.876	.856
	EF1=5	0	.	.	0	.	.
	EF2=1	-4.585	.000	.	1	.	.010
	EF2=2	-4.892	2.891	2.863	1	**.091**	.008

	EF2=3	-.629	1.405	.201	1	.654	.533
	EF2=4	.454	.845	.289	1	.591	1.574
	EF2=5	0	.	.	0	.	.
	EF3=1	-13.684	1011.969	.000	1	.989	1.141E-006
	EF3=2	-.852	1.321	.416	1	.519	.427
	EF3=3	-3.195	1.089	8.602	1	**.003**	.041
	EF3=4	-1.331	.893	2.220	1	.136	.264
	EF3=5	0	.	.	0	.	.
	EF4=1	-.136	1.154	.014	1	.906	.873
	EF4=2	.920	1.235	.556	1	.456	2.510
	EF4=3	.196	1.243	.025	1	.875	1.216
	EF4=4	-.362	1.224	.088	1	.767	.696
	EF4=5	0[b]	.	.	0	.	.
	EF5=1	-13.738	1469.475	.000	1	.993	1.080E-006
	EF5=2	-6.336	3.234	3.839	1	**.050**	.002
	EF5=3	.659	1.417	.216	1	.642	1.933
	EF5=4	1.787	.930	3.691	1	**.055**	5.970
	EF5=5	0	.	.	0	.	.
Closed Innovation	Intercept	-103.943	887.003	.014	1	.907	
	IF1=1	22.656	448.184	.003	1	.960	6906157607.515
	IF1=2	-16.445	676.540	.001	1	.981	7.215E-008
	IF1=3	-31.559	516.409	.004	1	.951	1.197E-013
	IF1=4	-75.938	792.253	.009	1	.924	1.000E-013
	IF1=5	0	.	.	0	.	.
	IF2=1	-18.965	1054.012	.000	1	.986	5.804E-009
	IF2=2	-53.479	789.141	.005	1	.946	1.000E-013

	IF2=3	34.397	884.925	.002	1	.969	867839768606984.500
	IF2=4	5.970	970.442	.000	1	.995	391.401
	IF2=5	0	.	.	0	.	.
	IF3=1	-18.489	891.087	.000	1	.983	9.338E-009
	IF3=2	12.451	478.466	.001	1	.979	255539.580
	IF3=3	-33.113	374.380	.008	1	.930	1.042E-013
	IF3=4	29.104	787.017	.001	1	.971	4363820483852.193
	IF3=5	0	.	.	0	.	.
	IF4=1	-46.700	2082.890	.001	1	.982	1.000E-013
	IF4=2	3.836	565.203	.000	1	.995	46.353
	IF4=3	-44.370	611.021	.005	1	.942	1.000E-013
	IF4=4	-15.995	978.354	.000	1	.987	1.131E-007
	IF4=5	0	.	.	0	.	.
	IF5=2	-80.154	1255.344	.004	1	.949	1.000E-013
	IF5=3	-39.048	1064.637	.001	1	.971	1.000E-013
	IF5=4	-15.104	808.517	.000	1	.985	2.756E-007
	IF5=5	0	.	.	0	.	.
	IF6=1	118.877	4607.759	.001	1	.979	4.243E+051
	IF6=2	67.752	760.102	.008	1	.929	2657871279664623600000000000000.00
	IF6=3	41.978	1099.272	.001	1	.970	1702214181694934020.00
	IF6=4	28.364	962.994	.001	1	.977	2081179711136.197
	IF6=5	0	.	.	0	.	.

	IFC1=1	-2.910	1454.438	.000	1	.998	.054
	IFC1=2	-26.566	1786.764	.000	1	.988	3.001E-012
	IFC1=3	-38.892	835.683	.002	1	.963	1.000E-013
	IFC1=4	-36.097	1138.610	.001	1	.975	1.002E-013
	IFC1=5	0	.	.	0	.	.
	IFC2=1	38.216	1732.294	.000	1	.982	39549148274205848.000
	IFC2=2	42.586	1821.743	.001	1	.981	31254204356 46226400.00
	IFC2=3	25.491	1382.313	.000	1	.985	11763918968 4.998
	IFC2=4	36.024	1714.908	.000	1	.983	44164713509 87669.000
	IFC2=5	0	.	.	0	.	.
	IFC3=1	131.098	1426.567	.008	1	.927	8.609E+056
	IFC3=2	53.554	2611.321	.000	1	.984	18116017840 80428700000 00.000
	IFC3=3	26.088	320.024	.007	1	.935	21378170372 6.927
	IFC3=4	-.655	938.231	.000	1	.999	.520
	IFC3=5	0	.	.	0	.	.
	IFC4=3	-38.196	1549.023	.001	1	.980	1.000E-013
	IFC4=4	-13.714	1206.862	.000	1	.991	1.106E-006
	IFC4=5	0	.	.	0	.	.
	IFC5=3	-65.846	3504.076	.000	1	.985	1.000E-013
	IFC5=4	19.649	1435.761	.000	1	.989	341692102.258

	IFC5=5	0	.	.	0	.	.
	IFC6=1	41.750	3088.502	.000	1	.989	13547087984 15219200.00 0
	IFC6=2	-47.710	1414.494	.001	1	.973	1.000E-013
	IFC6=3	86.798	887.990	.010	1	.922	4.966E+037
	IFC6=4	50.790	530.916	.009	1	.924	11419167991 32328200000 0.000
	IFC6=5	0	.	.	0	.	.
	IFC7=1	-88.348	2295.336	.001	1	.969	1.000E-013
	IFC7=2	-124.090	2188.891	.003	1	.955	1.000E-013
	IFC7=3	-37.989	863.561	.002	1	.965	1.000E-013
	IFC7=4	-24.264	405.800	.004	1	.952	2.911E-011
	IFC7=5	0	.	.	0	.	.
	IFC8=1	81.576	757.254	.012	1	.914	26788895723 98412500000 00000000000 000.000
	IFC8=2	44.372	2410.576	.000	1	.985	18644314153 532084000.0 00
	IFC8=3	98.375	2575.766	.001	1	.970	5.293E+042
	IFC8=4	25.255	740.746	.001	1	.973	92899958646 .349
	IFC8=5	0	.	.	0	.	.
	EF1=1	30.459	414.233	.005	1	.941	16916162442 571.979

	EF1=2	-9.391	651.806	.000	1	.989	8.345E-005
	EF1=3	-43.959	636.516	.005	1	.945	1.000E-013
	EF1=4	-50.706	605.213	.007	1	.933	1.000E-013
	EF1=5	0	.	.	0	.	.
	EF2=1	-19.321	7486.842	.000	1	.998	4.062E-009
	EF2=2	56.026	1236.514	.002	1	.964	2146946032166960700000000.000
	EF2=3	40.208	785.301	.003	1	.959	28974546769 2413310.000
	EF2=4	37.135	393.211	.009	1	.925	13414833048 499060.000
	EF2=5	0	.	.	0	.	.
	EF3=1	12.834	1986.873	.000	1	.995	374781.928
	EF3=2	-25.642	2188.182	.000	1	.991	7.408E-012
	EF3=3	33.010	942.773	.001	1	.972	21683505350 8051.000
	EF3=4	22.863	488.896	.002	1	.963	8498844312. 365
	EF3=5	0	.	.	0	.	.
	EF4=1	-4.672	1047.961	.000	1	.996	.009
	EF4=2	5.048	661.890	.000	1	.994	155.736
	EF4=3	26.035	694.295	.001	1	.970	20276291705 6.473
	EF4=4	4.064	686.998	.000	1	.995	58.179
	EF4=5	0	.	.	0	.	.
	EF5=1	-49.698	3157.537	.000	1	.987	1.000E-013
	EF5=2	-32.472	797.507	.002	1	.968	1.079E-013

	EF5=3	-20.073	2468.259	.000	1	.994	1.916E-009
	EF5=4	29.894	338.807	.008	1	.930	9612677325872.451
	EF5=5	0	.	.	0	.	.

Source: Survey Output

The table provides the information of the model fit. From the table, it can be said that model is fit at 99% significance level. This indicates that the null hypothesis i.e. H_{01} is not accepted. This means that the firm level factors or the internal factors and external factors of the firm has a significant influence on the adoption of innovation approach. The extent to which these factors influence to adopt Open Innovation and Closed Innovation compared to both the approaches are given in the parameter estimates. The Nagelkerke explains more variance among the variables as compared to Cox and shell, McFadden. The explanation for variance is about 86.9%.

From the likelihood ratio table, the internal factors that may likely influence the firm to adopt innovation can be found. From the table, it is clear that firm-level factors such as firm size, Education of the entrepreneur, and certain cultural factors of the firm, may likely influence the firm to adopt the innovation approach.

6.4.1 Factors influencing adoption of Open Innovation as compared to both the approaches.

6.4.1.1 Age of the firm

The results indicate that the age is the firm is one of the factors that influence the firm to adopt innovation and is significant statistically and negative. The results are significant for all the location of the Likert scale except for location 2. The firms strongly disagreement level, neutrality and agreement level decreases significantly compared to the strongly agreement level among the SME decision makers about the influence of age on adoption of open innovation practices compared to both. This means firms believe that

age of the firm is a significant factor in adopting an innovation. An inference can be drawn that newer firms adopt more as compared to the older firms.

6.4.1.2 Size of the firm

The result indicates that size of the significantly influences the firm in adopting an open innovation. The significance is negative at location 4 and at all other location the results are insignificant. The agreement decreases in the adoption of open innovation compared to strongly agree among the respondents. This indicates that as the adoption of Open innovation compared to the adoption of both practices decreases as the size of the firm increases.

6.4.1.3 Education of the decision maker

The result indicates that education level of the decision maker is significant negatively at the location neutral on the Likert scale. This means that the neutrality in the response decreases as compared to a strongly agreement. This shows that the education level of the decision makers is more likely to influence adoption of open innovation as compared to both the approaches of innovation.

6.4.1.4 Experience of the entrepreneur

The result indicates that experience of the entrepreneur is significant to the adoption of innovation. The significance is positive at location 4 and negative at location 1. The result is positively significant at location 4 of the Likert scale indicates that the agreement of the respondent's increases as compared to strongly agreement level in the adoption of open innovation as compared to both the innovation approaches. This means the experience of the entrepreneur is likely to influence the adoption of open innovation compared to both the approaches increases. The negative significance at location 1 indicates that the strongly disagreement compared to strongly agreement decreases. This means the experience of the decision maker influences the SMEs to adopt open innovation practices as compared to both the practices.

6.4.1.5 Emphasis on Research and Development

The result indicates that emphasis on research and development is significant to adopt innovation approach. The significance is positive at location 3 on the Likert scale. This means the neutrality of the response increase as compared to strongly agree for the adoption of open innovation as compared to both the approaches. This indicates that SMEs are not sure that adoption of Open Innovation approach is influenced if the emphasis on R&D is given in their firm.

6.4.1.6 Investment in Research and Development

The result indicates that investment in research and development among SMEs is not a significant factor in adopting innovation since the results are statistically insignificant.

6.4.1.7 Cultural Factor 1: Innovation practices are perceived as too risky in our firm

The result indicates that this factor of cultural is not significant statistically. Hence it can be said that this factor will not influence to adopt an innovation.

6.4.1.8 Cultural Factor 2: In our firm, we seek innovative ideas from our internal sources only

The result indicates that this factor of cultural is not significant statistically. Hence it can be said SMEs with a culture that seeks innovative ideas from our internal sources alone do not influence to adopt an innovation.

6.4.1.9 Cultural Factor 3: In our firm, we are keen on sourcing ideas from external sources also

The result indicates that this factor of cultural is significant. The significance is positive at location 2 on the Likert scale. This indicates that SMEs who are keen on sourcing ideas from external sources is also a key cultural factor for innovation. But the results indicate that the disagreement increases as compared to strongly agree. So it can be inferred that

sourcing of ideas from external sources will be most likely to decrease the adoption of open innovation compared to both innovation approaches.

6.4.1.10 Cultural Factor 4: We promote innovative ideas in our firm

The result indicates that this factor of cultural is not significant statistically. This shows that for the adoption of innovation, this factor most likely may not be influencing.

6.4.1.11 Cultural factor 5: We support innovative ideas in our firm

The result indicates that this factor of cultural is not significant statistically. This shows that for the adoption of innovation, this factor most likely may not be influencing.

6.4.1.12 Cultural factor 6: In our firm, Employees are rewarded for proposing new ideas

The result indicates that this factor of cultural is significant. The significance is positive at the location 2 and 3 on the scale. But the results indicate that the disagreement increases as compared to strongly agree and neutrality also increases with respect to strongly agree. So it can be inferred that rewarding employees for proposing new ideas will be most likely to decrease the adoption of open innovation. This indicates that SMEs who have a culture of rewarding employees for proposing new idea significantly negatively influence the adoption of open innovation.

6.4.1.13 Cultural factor 7: In our firm, Employees are not hesitant to speak about new idea for better performance

The result indicates that this factor of culture is significant. The significance is positive at location 2 and 3. This means that disagreement increases as compared to strongly agree and neutrality also increases with respect to strongly agree. The results also show that some SMEs feel that they are still not clear whether employees are really expressive in coming out with the new idea during the discussion for better performance whereas other

SMEs in the survey feel that Employees are not expressive in giving ideas for better performance.

6.4.1.14 Cultural factor 8: In our firm, Employees are not penalized if the new ideas proposed do not work

The result indicates that this factor of culture is significant to adopt an innovation. The significance is negative at location 1 of the scale. This indicates that the strongly disagreement decreases as compared to strongly agreement. This means the SMEs who have adopted open innovation as compared to both the approach most likely have a culture of not penalizing the employees if the proposed idea of the employee does not produce results.

6.4.1.15 Competition

The result indicates that competition influences the firm to adopt an innovation. The results are significant and are positive at location 2 and 3 of the Likert scale. This indicates that the disagreement level among the SMEs increases with respect to strongly agree and the neutrality also increases with respect to strongly agree. This means competition most likely may not influence to adopt open innovation compared to both the approach.

6.4.1.16 Customers

The results indicate that customers influence the SMEs to adopt an innovation. The results are significant at location 2, and the significance is negative. This means that the disagreement level as compared to strongly agree decreases for the adoption of open innovation as compared to both the approaches. This indicates that SMEs feel those customers are more likely to be influencing factor in adoption of open innovation compared to adopt both the innovation approach

6.4.1.17 Ecosystem

The result of the ecosystem influence on adoption of open innovation as compared to both the approaches is significant. The significant is negative at location 3. This indicates that the neutrality decreases as compared to strong agree. This means SMEs opinion on the influence of ecosystem on adoption of open innovation is still undecided but is leaning towards the adoption of open innovation.

6.4.1.18 Government Policies

The result indicates the government policies may not influence the SMEs to adopt innovation since the results are statistically insignificant.

6.4.1.19 Technological Advances

The result indicates that advances in technology are a significant factor that influences SMEs to adopt an open innovation. The results are significant at location 2 and 4. The results are negatively significant at location 2 and positive at location 4. The disagreement decreases as compared to strongly agree and agreement increases as compared to strongly agree for the adoption of open innovation. Hence it can be said that technological advances influence SMEs to adopt an open innovation.

6.4.2 Factors influencing adoption of Closed Innovation as compared to both the approaches.

The results indicate that together both firm-level factors and external factors to the SMEs do not influence to adopt closed innovation as compared to both the approaches since all the factors are statistically insignificant.

6.4.3 Inferences

The study results indicate that firm age negatively influences the adoption of open innovation approach compared to both approaches. The result is in concurrence with the

results of Mazzola et al. (2012) and Mina et al. (2014). The result also indicates that firm age influences the adoption of open innovation and do not influence to adopt closed innovation approach.

The study result confirms the results of Mazzola et al. (2012) for size as an important factor for adoption of innovation and influences negatively. The study result disagrees with the results of Lichtenthaler (2008), Abulrub and Lee (2012), Mina et al. (2014), and Ren et al. (2015). The results also indicate that size of the firm negatively influences in the adoption of open innovation and do not influence to adopt closed innovation approach.

The education qualification of the decision maker of SMEs significantly influences the adoption of innovation. The results agree with the study of Bayarcelik, Tasel, and Apak (2014) but their influence differs considerably. For adoption of open approach, they influence negatively and do not influence to adopt closed innovation approach

The experience of decision maker significantly influences the adoption of innovation. For adoption of the open approach, they influence positively and do not influence to adopt closed innovation approach.

The firm culture has an influence on adoption on open innovation and but do not influence to adopt closed innovation. The results agree with the study of Roper (1997), Chen et al. (2008), Gumus and Cubukcu (2011), Mbizi et al.(2013), Bayarcelik, Tasel and Apak (2014).

The results indicate that investment in R & D in SMEs is not a significant influencing factor in adopting open innovation and closed innovation. The results differ with the earlier studies (Chen and Chen, 2005; Yifeng, 2011; Bianchi et al., 2016)

With respect to external factor competition, the result indicates that competition influences SMEs to adopt open innovation compared to both the approaches. These results are consistent with results of Nicita et al. (2005) and Aminullah and Adnan (2012).

Customers influence SMEs positively to adopt open innovation compared to both the approaches whereas to adopt closed innovation customers do not influence. These results are inconsistent with the results of Klewitz and Hansen (2013).

Ecosystem negatively influences SMEs to adopt open innovation and do not influences to adopt closed innovation. These results concur with the results of Nicita et al. (2005) and Masson (2013).

Government policies do not significantly influence SMEs to adopt any innovation approach. These results are contradicting the results of earlier researchers (Hakkim and Heidrick, 2008; Ghafele and O'Brien, 2013; Wynarczyk, 2013; Hamdani and Wirawan, 2012; Cooke and Wills, 1999; Krapex, Skerlavaj and Groznik, 2012).

Technological advances will influence the SMEs to adopt open innovation approaches compared to both the approaches but do not influence to adopt closed innovation approach compared to both the approaches. The results differ with the results of earlier researchers (Wynarczyk, 2013; Gourova and Toteva, 2012; Bayarcelik, Tasel and Apak, 2014).

6.5 Summary

The adoption of innovation approaches by SMEs and the factors influencing them can be studied in three different ways. The influence of firm-level factors alone is taken into consideration for the adoption of innovation approach; it is found that Firm age, Firm size, Education level, Experience of the decision maker, the culture of the firm influences the SMEs to adopt open innovation as compared to adoption both the approaches. Further Firm Age, Firm Size, Experience of the decision maker, the culture of the firm and to an extent the emphasis on R&D influences SMEs to adopt closed innovation compared to the adoption of both the approaches.

When only Firm external factors are considered, factors such as competition, and Eco System has influence to adopt both approaches compared to open approaches and closed whereas customers, Government Policies, and Technological Advances do not influence

the SMEs to adopt open innovation or closed innovation approach compared to both the approaches.

When both the firm level factors and external factors together are considered, it is found that these factors only influence the SMEs to adopt open innovation but not closed innovation. The factors that influence the SMEs to adopt an open innovation are Firm Age, Firm Size, and Experience of the decision maker, Education of the decision maker, certain cultural factors, Competition, Customer, Eco-system and technological advances.

Chapter 7

Innovation Practices and Firm Performance

7.1 Introduction

This chapter discusses the open innovation and closed innovation practices of SMEs and its influence on firm performance. The open innovation practices are idea generation through external sources, participation in trade shows, product development with external agents, collaboration activities for technology exploration with academic institutions, suppliers, Research & Development centers and customers, Spin-off and Intellectual Property Rights Trading. The closed innovation practices include idea generation through internal sources and product development with the help of internal resources only. The extent of influence of these practices on firm performance with respect to overall, change in market share, change in revenue, change in product sales and able to come up with more products is discussed here.

7.1.1 Open Innovation practices and its influence on overall firm Performance

The open innovation practices such as idea generation through internal and external sources(OIP1), participation in trade shows(OIP7), product development with internal external sources(OIP2), collaboration activities for technology exploration with academic institutions(OIP3), suppliers(OIP4), Research & Development centers(OIP5) and customers(OIP6), Intellectual Property Rights Licensing(OIP8), Intellectual Property Rights purchases(OIP9), Trading Intellectual Property Rights Trading sell out(OIP10), Spin-off(OIP11), and alliance(OIP12) are the independent variables and the overall performance is the dependent variable.

The following hypothesis tests the relationship between dependent and independent variables.

H_{03a1}: Practices of Open Innovation approaches do not significantly improve performance of the firm

H_{A3a1}: Practices of Open Innovation approaches do significantly improve performance of the firm

To measure the hypothesis, an ordinal logistic regression is estimated between the dependent variable and independent variable.

$Ln(Y') = \alpha_j - (\beta_1 OIP1 + \beta_2 OIP2 + \beta_3 OIP3 + \beta_4 OIP4 + \beta_5 OIP5 + \beta_6 OIP6 + \beta_7 OIP7 + \beta_8 OIP8 + \beta_9 OIP9 + \beta_{10} OIP10 + \beta_{11} OIP11 + \beta_{12} OIP12) + €$ …….. (1)

Where β_1, β_2, β_3… β_{12} are logit coefficients. When there are j categories, the Proportional Odds model estimates J-1 cut points, and € is the standard error.

Y is the dependent variable overall performance and OIP1 to OIP12 are the open innovation practices.

Table 7.1 Model Fitting Information Open Innovation Practices and overall Firm Performance

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	590.987			
Final	482.613	108.375	48	.000

Source: Survey Output

Table 7.1 discusses the model fit information of the ordinal logistic regression. From the table, it is observed that the p-value is 0.000 and is significant at 99% level. This indicates that the alternate hypothesis H_{A4a1} i.e. Practices of Open Innovation approaches do significantly improve the performance of the firm is not rejected. This means SMEs who are practicing open innovation approach are likely to improve their overall firm performance.

Table 7.2 Pseudo R-Square Open Innovation Practices and overall Firm Performance

Pseudo R-Square Method	Pseudo R-Square Value
Cox and Snell	0.399
Nagelkerke	0.425
McFadden	0.182

Source: Survey Output

Table 7.2 provides the pseudo-R-square values. R-square explains the variance among the variables. From the table it can be said that as per Nagelkerke 42.5% variance is explained, Cox and Snell's values explain the variance about 39.9% and as per McFadden the variance among the variables is explained to the tune of 18.2%.

Table 7.3 Parameter estimates of Open Innovation Practices and overall Firm Performance (FP)

		Estimate	Std. Error	Wald	df	Sig.
Threshold	FP Overall = 1	-8.272	1.242	44.337	1	.000
	FP Overall = 2	-7.140	.943	57.291	1	.000
	FP Overall = 3	-6.398	.849	56.818	1	.000
	FP Overall = 4	-4.347	.744	34.169	1	.000
	FP Overall = 5	-3.098	.717	18.659	1	.000
	FP Overall = 6	-.976	.683	2.043	1	.153
Location	OIP1=1	-4.769	1.682	8.038	1	.005*
	OIP1=2	-2.583	.961	7.225	1	.007*
	OIP1=3	-1.020	.565	3.265	1	.071***
	OIP1=4	-.372	.444	.702	1	.402
	OIP1=5	0	.	.	0	.
	OIP2=1	1.188	.832	2.036	1	.154
	OIP2=2	-.055	.676	.007	1	.935

	OIP2=3	.115	.606	.036	1	.850
	OIP2=4	-.759	.531	2.043	1	.153
	OIP2=5	0	.	.	0	.
	OIP3=1	-.830	.706	1.381	1	.240
	OIP3=2	-.813	.683	1.419	1	.234
	OIP3=3	-1.480	.702	4.438	1	.035**
	OIP3=4	-1.234	.682	3.275	1	.070***
	OIP3=5	0	.	.	0	.
	OIP4=1	-.344	.797	.187	1	.666
	OIP4=2	-.100	.693	.021	1	.885
	OIP4=3	-.727	.608	1.428	1	.232
	OIP4=4	-.785	.567	1.922	1	.166
	OIP4=5	0	.	.	0	.
	OIP5=1	1.784	.852	4.386	1	.036**
	OIP5=2	1.903	.845	5.074	1	.024**
	OIP5=3	1.822	.822	4.910	1	.027**
	OIP5=4	2.741	.879	9.726	1	.002*
	OIP5=5	0	.	.	0	.
	OIP6=1	-2.745	.927	8.760	1	.003*
	OIP6=2	.084	.819	.010	1	.919
	OIP6=3	-.128	.525	.060	1	.807
	OIP6=4	-.253	.404	.394	1	.530
	OIP6=5	0	.	.	0	.
	OIP7=1	-.043	.692	.004	1	.950
	OIP7=2	-.261	.639	.167	1	.683
	OIP7=3	.296	.552	.288	1	.591
	OIP7=4	-.193	.624	.096	1	.757
	OIP7=5	0	.	.	0	.

	OIP8=1	1.164	.745	2.440	1	.118
	OIP8=2	-1.008	.723	1.947	1	.163
	OIP8=3	.302	.621	.237	1	.626
	OIP8=4	.813	.617	1.736	1	.188
	OIP8=5	0	.	.	0	.
	OIP9=1	-.213	.809	.069	1	.792
	OIP9=2	-.249	.657	.144	1	.704
	OIP9=3	.638	.615	1.074	1	.300
	OIP9=4	.247	.562	.193	1	.661
	OIP9=5	0	.	.	0	.
	OIP10=1	.989	.732	1.824	1	.177
	OIP10=2	1.280	.808	2.509	1	.113
	OIP10=3	.586	.735	.634	1	.426
	OIP10=4	.495	.726	.464	1	.496
	OIP10=5	0	.	.	0	.
	OIP11=1	-.859	.931	.850	1	.357
	OIP11=2	-.963	.643	2.239	1	.135
	OIP11=3	-2.083	.566	13.530	1	.000*
	OIP11=4	-1.688	.567	8.875	1	.003*
	OIP11=5	0	.	.	0	.
	OIP12=1	-1.709	.802	4.546	1	.033**
	OIP12=2	-1.567	.663	5.593	1	.018**
	OIP12=3	-1.697	.532	10.184	1	.001*
	OIP12=4	-1.347	.464	8.416	1	.004*
	OIP12=5	0	.	.	0	.

Source: Survey Output

* 99% significance level, **95% significance level and *** 90% significance level

From the table 7.3, it is observed that open innovation practices such as idea generation by both internal and external sources(OIP1), collaboration with academic institutes(OIP3), collaboration with R&D institutes(OIP5), collaboration with customer(OIP6), Spin-off(OIP11), and alliance(OIP12) significantly influence to improve the overall firm performance.

SME's strongly disagreement level, disagreement level and neutrality decrease compared to strongly agreement for the open innovation practice of generating ideas from both the sources i.e. internal and external sources. This indicates that firm's overall performance is more likely to improve if this approach is adopted by the firms.

SME's agreement level with respect to strongly agree level decreases for the open innovation practice of collaboration with academic institutes. This indicates that if the firm practices this approach then less likely it will improve firm performance.

SME's strongly disagreement level and disagreements level increases compared to strongly agree for the open innovation practice of collaborating with R & D labs. This indicates that firm performance most likely may improve negatively if this approach is practiced.

SME's strongly disagreement level decrease compared to strongly agreement for the open innovation practice of collaborations with customers. This indicates that if the firm practices this approach then an improvement in overall firm performance can be seen.

SME's practice spin-off as an open innovation approach and the neutrality decreases with respect to strongly agree, and agreement level also decreases with respect to strongly agree. This indicates that adoption of the spin-off as open innovation practice will be less likely to improve the firm performance.

SME's do practice alliance as their approach to open innovation. It is found that their neutrality on the practice of alliance decreases with respect to strongly agree and agreement level also decreases with respect to strongly agree. The result also indicates that adoption of the alliance as open innovation practice will be less likely to improve the firm performance.

7.1.2 Open Innovation practices and its influence on firm Performance with respect to Market Share

The open innovation practices such as idea generation through internal and external sources(OIP1), participation in trade shows(OIP7), product development with internal external sources(OIP2), collaboration activities for technology exploration with academic institutions(OIP3), suppliers(OIP4), Research & Development centers(OIP5) and customers(OIP6), Intellectual Property Rights Licensing(OIP8), Intellectual Property Rights purchases(OIP9), Trading Intellectual Property Rights Trading sell out(OIP10), Spin-off(OIP11), and alliance(OIP12) are the independent variables and the change in market share is the dependent variable.

The following hypothesis tests the relationship between dependent and independent variables.

H_{03a2}: Practices of Open Innovation approaches do not significantly influence the firm's market share

H_{A3a2}: Practices of Open Innovation approaches do significantly influence the firm's market share

To measure the hypothesis, an ordinal logistic regression is estimated between the dependent variable and independent variable.

$$Ln(Y') = \alpha_j - (\beta_1 OIP1 + \beta_2 OIP2 + \beta_3 OIP3 + \beta_4 OIP4 + \beta_5 OIP5 + \beta_6 OIP6 + \beta_7 OIP7 + \beta_8 OIP8 + \beta_9 OIP9 + \beta_{10} OIP10 + \beta_{11} OIP11 + \beta_{12} OIP12) + € \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where β_1, β_2, β_3… β_{12} are logit coefficients. When there are j categories, the Proportional Odds model estimates J-1 cut points, and € is the standard error.

Table 7.4 Model Fitting Information

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	615.306			
Final	553.477	61.829	48	.087

Source: Survey Output

Table 7.4 discusses the model fit information of the ordinal logistic regression. From the table, it is observed that the p-value is 0.087 and is significant at 95% level. This indicates that the alternate hypothesis H_{A4a1} i.e. Practices of Open Innovation approaches do significantly influence the firm's market share is not rejected. This means SMEs market share will be influenced if open innovation approach is practiced.

Table 7.5 Pseudo R-Square Open Innovation Practices and Market Share

Pseudo R-Square Method	Pseudo R-Square Value
Cox and Snell	0.252
Nagelkerke	0.266
McFadden	0.099

Source: Survey Output

Table 7.5 provides the pseudo-R-square values. R-square explains the variance among the variables. From the table it can be said that as per Nagelkerke 26.6% variance is explained, Cox and Snell's values explain the variance about 25.2% and as per McFadden the variance among the variables is explained about 9.9%.

Table 7.6 Parameter estimates of Open Innovation Practices (OIP) and Market Share (MS)

		Estimate	Std. Error	Wald	df	Sig.
Threshold	MS = 1	-5.489	.868	40.005	1	.000
	MS = 3	-4.552	.736	38.240	1	.000
	MS = 4	-1.986	.623	10.163	1	.001
	MS = 5	-1.144	.613	3.486	1	.062
	MS = 6	.179	.607	.087	1	.768
Location	OIP1=1	**-4.762**	**1.735**	**7.530**	**1**	**.006***
	OIP1=2	**-2.357**	**.929**	**6.437**	**1**	**.011****
	OIP1=3	**-1.313**	**.550**	**5.700**	**1**	**.017****
	OIP1=4	-.608	.439	1.919	1	.166
	OIP1=5	0	.	.	0	.
	OIP2=1	-.108	.782	.019	1	.891
	OIP2=2	.554	.647	.734	1	.392
	OIP2=3	-.203	.561	.131	1	.717
	OIP2=4	-.238	.505	.223	1	.637
	OIP2=5	0	.	.	0	.
	OIP3=1	-.817	.639	1.636	1	.201
	OIP3=2	-.372	.601	.383	1	.536
	OIP3=3	.255	.622	.168	1	.682
	OIP3=4	-.140	.595	.055	1	.814
	OIP3=5	0	.	.	0	.
	OIP4=1	.713	.738	.934	1	.334
	OIP4=2	.536	.656	.666	1	.414
	OIP4=3	-.680	.563	1.458	1	.227

	OIP4=4	-.220	.524	.176	1	.674
	OIP4=5	0	.	.	0	.
	OIP5=1	1.064	.788	1.823	1	.177
	OIP5=2	.368	.777	.224	1	.636
	OIP5=3	.207	.742	.078	1	.781
	OIP5=4	.485	.764	.403	1	.526
	OIP5=5	0	.	.	0	.
	OIP6=1	-1.320	.897	2.165	1	.141
	OIP6=2	1.034	.844	1.503	1	.220
	OIP6=3	-.035	.499	.005	1	.944
	OIP6=4	.242	.379	.408	1	.523
	OIP6=5	0	.	.	0	.
	OIP7=1	.024	.658	.001	1	.971
	OIP7=2	-.331	.610	.294	1	.588
	OIP7=3	.723	.528	1.870	1	.171
	OIP7=4	-.659	.596	1.221	1	.269
	OIP7=5	0	.	.	0	.
	OIP8=1	.370	.684	.293	1	.588
	OIP8=2	.615	.689	.796	1	.372
	OIP8=3	.428	.569	.565	1	.452
	OIP8=4	.582	.566	1.058	1	.304
	OIP8=5	0	.	.	0	.
	OIP9=1	-.829	.723	1.313	1	.252
	OIP9=2	-.781	.614	1.620	1	.203
	OIP9=3	.690	.577	1.432	1	.231
	OIP9=4	.305	.512	.354	1	.552
	OIP9=5	0	.	.	0	.
	OIP10=1	.036	.674	.003	1	.957

	OIP10=2	-.393	.726	.293	1	.588
	OIP10=3	-.757	.653	1.343	1	.247
	OIP10=4	-.781	.646	1.463	1	.226
	OIP10=5	0	.	.	0	.
	OIP11=1	-.192	.809	.056	1	.812
	OIP11=2	.383	.583	.431	1	.511
	OIP11=3	.370	.491	.567	1	.452
	OIP11=4	.262	.495	.279	1	.597
	OIP11=5	0	.	.	0	.
	OIP12=1	.118	.733	.026	1	.872
	OIP12=2	-.831	.641	1.682	1	.195
	OIP12=3	-.817	.498	2.687	1	.101
	OIP12=4	-.588	.426	1.911	1	.167
	OIP12=5	0	.	.	0	.

Source: Survey Output

* 99% significance level, and **95% significance level

From the table 7.6, it is observed that open innovation practices such as idea generation by both internal and external sources (OIP1) significantly influence to improve the market share performance.

SME's strongly disagreement level, disagreement level and neutrality level decreases compared to strongly agreement for the open innovation practice of generating ideas from both the sources i.e. internal and external. This indicates that firm's market share is more likely to be influenced if SMEs generate ideas using both the sources i.e. internal and external sources.

7.1.3 Open Innovation practices and its influence on Firm Performance with respect to Revenue

The open innovation practices such as idea generation through internal and external sources(OIP1), participation in trade shows(OIP7), product development with internal external sources(OIP2), collaboration activities for technology exploration with academic institutions(OIP3), suppliers(OIP4), Research & Development centers(OIP5) and customers(OIP6), Intellectual Property Rights Licensing(OIP8), Intellectual Property Rights purchases(OIP9), Trading Intellectual Property Rights Trading sell out(OIP10), Spin-off(OIP11), and alliance(OIP12) are the independent variables and the change in revenue is the dependent variable.

The following hypothesis tests the relationship between dependent and independent variables.

H_{03a3}: Practices of Open Innovation approaches do not significantly influence the firm's Revenue

H_{A3a3}: Practices of Open Innovation approaches do significantly influence the firm's Revenue

To measure the hypothesis, an ordinal logistic regression is estimated between the dependent variable and independent variable.

$$Ln(Y') = \alpha_j - (\beta_1 OIP1 + \beta_2 OIP2 + \beta_3 OIP3 + \beta_4 OIP4 + \beta_5 OIP5 + \beta_6 OIP6 + \beta_7 OIP7 + \beta_8 OIP8 + \beta_9 OIP9 + \beta_{10} OIP10 + \beta_{11} OIP11 + \beta_{12} OIP12) + € \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where β_1, β_2, $\beta_3 \ldots$ β_{12} are logit coefficients. When there are j categories, the Proportional Odds model estimates J-1 cut points, and € is the standard error.

Table 7.7 Model Fitting Information Open Innovation Practices and Revenue

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	580.998			
Final	523.746	57.252	48	0.169

Source: Survey Output

Table 7.7 discusses the model fit information of the ordinal logistic regression. From the table, it is observed that the p-value is 0.169 and is insignificant at 99%, 95% , and 90% level. Hence the null hypothesis H_{04a3} i.e. Practices of Open Innovation approaches do not significantly influence the firm's revenue is not rejected. This means SMEs revenue will be not be influenced if open innovation approach is practiced.

Table 7.8 Pseudo R-Square Open Innovation Practices and Revenue

Pseudo R-Square Method	Pseudo R-Square Value
Cox and Snell	0.236
Nagelkerke	0.252
McFadden	0.097

Source: Survey Output

Table 7.8 provides the pseudo-R-square values. R-square explains the variance among the variables. From the table it can be said that as per Nagelkerke 25.2% variance is explained, Cox and Snell's values explain the variance about 23.6% and as per McFadden the variance among the variables is explained about 9.7%.

Table 7.9 Parameter estimates of Open Innovation Practices (OIP) and Revenue

		Estimate	Std. Error	Wald	df	Sig.
Threshold	Revenue = 3	-5.930	1.177	25.385	1	.000
	Revenue = 4	-1.407	.620	5.160	1	.023
	Revenue = 5	-.476	.613	.603	1	.437
	Revenue = 6	.816	.615	1.761	1	.185
Location	OIP1=1	-2.983	1.723	2.998	1	.083
	OIP1=2	-1.893	.971	3.803	1	.051***
	OIP1=3	-.458	.545	.706	1	.401
	OIP1=4	-.169	.437	.150	1	.698
	OIP1=5	0	.	.	0	.
	OIP2=1	-.388	.793	.240	1	.624
	OIP2=2	.920	.675	1.859	1	.173
	OIP2=3	-.388	.556	.488	1	.485
	OIP2=4	-.486	.504	.930	1	.335
	OIP2=5	0	.	.	0	.
	OIP3=1	-.074	.636	.014	1	.907
	OIP3=2	.462	.601	.591	1	.442
	OIP3=3	.572	.619	.853	1	.356
	OIP3=4	.067	.596	.012	1	.911
	OIP3=5	0	.	.	0	.
	OIP4=1	1.427	.734	3.781	1	.052***
	OIP4=2	1.060	.671	2.499	1	.114
	OIP4=3	.017	.555	.001	1	.976
	OIP4=4	.261	.523	.249	1	.618
	OIP4=5	0	.	.	0	.

	OIP5=1	1.448	.804	3.245	1	.072***
	OIP5=2	.909	.782	1.352	1	.245
	OIP5=3	.942	.751	1.576	1	.209
	OIP5=4	.953	.770	1.533	1	.216
	OIP5=5	0	.	.	0	.
	OIP6=1	-1.602	.926	2.994	1	.084***
	OIP6=2	.670	.829	.654	1	.419
	OIP6=3	-.243	.499	.237	1	.627
	OIP6=4	-.259	.379	.467	1	.494
	OIP6=5	0	.	.	0	.
	OIP7=1	-.832	.671	1.537	1	.215
	OIP7=2	-.790	.622	1.614	1	.204
	OIP7=3	-.357	.528	.457	1	.499
	OIP7=4	-.183	.609	.091	1	.763
	OIP7=5	0	.	.	0	.
	OIP8=1	.637	.684	.867	1	.352
	OIP8=2	.163	.689	.056	1	.814
	OIP8=3	.748	.578	1.674	1	.196
	OIP8=4	.269	.567	.225	1	.635
	OIP8=5	0	.	.	0	.
	OIP9=1	-1.128	.741	2.316	1	.128
	OIP9=2	-1.140	.626	3.311	1	.069***
	OIP9=3	.017	.574	.001	1	.976
	OIP9=4	-.078	.519	.023	1	.880
	OIP9=5	0	.	.	0	.
	OIP10=1	-.521	.675	.595	1	.440
	OIP10=2	-.674	.736	.838	1	.360
	OIP10=3	-1.778	.670	7.035	1	.008*

	OIP10=4	-1.111	.654	2.886	1	.089
	OIP10=5	0	.	.	0	.
	OIP11=1	.030	.818	.001	1	.971
	OIP11=2	.447	.584	.585	1	.444
	OIP11=3	.724	.493	2.161	1	.142
	OIP11=4	.157	.494	.101	1	.750
	OIP11=5	0	.	.	0	.
	OIP12=1	.411	.734	.313	1	.576
	OIP12=2	-.745	.630	1.400	1	.237
	OIP12=3	-.118	.498	.057	1	.812
	OIP12=4	.036	.422	.007	1	.932
	OIP12=5	0	.	.	0	.

Source: Survey Output

* 99% significance level, and *** 90% significance level

Even though the overall regression model is found to be not fit, but the estimates indicate that certain practices such as generation of idea from both the sources, collaboration with suppliers, collaboration with Research & Development centers, collaboration with customers, and Intellectual Property Rights purchases may have some influence on change in revenue of the firm.

7.1.4 Open Innovation Practices and firm performance with reference to Product Sales

The open innovation practices such as idea generation through internal and external sources(OIP1), product development with internal external sources(OIP2), collaboration activities for technology exploration with academic institutions(OIP3), suppliers(OIP4), Research & Development centers(OIP5) and customers(OIP6), participation in trade shows(OIP7), Intellectual Property Rights Licensing(OIP8), Intellectual Property Rights

purchases(OIP9), Trading Intellectual Property Rights Trading sell out(OIP10), Spin-off(OIP11), and alliance(OIP12) are the independent variables and the product sales is the dependent variable.

The following hypothesis tests the relationship between dependent and independent variables.

H_{03a4}: Practices of Open Innovation approaches do not significantly influence the firm's Product Sales

H_{A3a4}: Practices of Open Innovation approaches do significantly influence the firm's Product Sales

To measure the hypothesis, an ordinal logistic regression is estimated between the dependent variable and independent variable.

$$Ln(Y') = \alpha_j - (\beta_1 OIP1 + \beta_2 OIP2 + \beta_3 OIP3 + \beta_4 OIP4 + \beta_5 OIP5 + \beta_6 OIP6 + \beta_7 OIP7 + \beta_8 OIP8 + \beta_9 OIP9 + \beta_{10} OIP10 + \beta_{11} OIP11 + \beta_{12} OIP12) + € \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where β_1, β_2, $\beta_3 \ldots$ β_{12} are logit coefficients. When there are j categories, the Proportional Odds model estimates J-1 cut points, and € is the standard error.

Table 7.10 Model Fitting Information Pseudo R-Square Open Innovation approach and Product Sales

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	580.761			
Final	530.841	49.921	48	.397

Source: Survey Output

Table 7.10 discusses the model fit information of the ordinal logistic regression. From the table, it is observed that the p-value is 0.397 and is insignificant at 99%, 95% , and 90%

level. Hence the null hypothesis H_{04a4} i.e. Practices of Open Innovation approaches do not significantly influence the firm's product sales is not rejected. This means SMEs product sales will be not be influenced if open innovation approach is practiced.

Table 7.11 Pseudo R-Square Open Innovation approach and Product Sales

Pseudo R-Square Method	Pseudo R-Square Value
Cox and Snell	.209
Nagelkerke	.223
McFadden	.085

Source: Survey Output

Table 7.11 provides the pseudo-R-square values. R-square explains the variance among the variables. From the table it can be said that as per Nagelkerke 22.3% variance is explained, Cox and Snell's values explain the variance about 20.9% and as per McFadden the variance among the variables is explained about 8.5%.

Table 7.12 Parameter Estimates for Open Innovation Practices (OIP) and Product Sales (PS)

		Estimate	Std. Error	Wald	df	Sig.
Threshold	PS = 2	-5.983	1.187	25.412	1	.000
	PS = 4	-1.544	.616	6.284	1	.012
	PS = 5	-.498	.608	.671	1	.413
	PS = 6	.599	.608	.972	1	.324
Location	OIP1=1	-3.025	1.728	3.065	1	.080***
	OIP1=2	-1.478	.952	2.410	1	.121
	OIP1=3	-.366	.540	.460	1	.498
	OIP1=4	-.022	.432	.003	1	.960
	OIP1=5	0[a]	.	.	0	.
	OIP2=1	.168	.794	.045	1	.832
	OIP2=2	.580	.658	.778	1	.378
	OIP2=3	-.144	.553	.068	1	.795
	OIP2=4	-.313	.498	.394	1	.530
	OIP2=5	0[a]	.	.	0	.
	OIP3=1	-.081	.634	.016	1	.899
	OIP3=2	-.014	.599	.001	1	.981
	OIP3=3	.286	.618	.215	1	.643
	OIP3=4	.064	.594	.012	1	.914
	OIP3=5	0[a]	.	.	0	.
	OIP4=1	.575	.718	.641	1	.423
	OIP4=2	.935	.678	1.905	1	.168
	OIP4=3	-.303	.557	.295	1	.587
	OIP4=4	-.288	.523	.303	1	.582

	OIP4=5	0[a]	.	.	0	.
	OIP5=1	1.442	.792	3.316	1	.069***
	OIP5=2	1.217	.776	2.460	1	.117
	OIP5=3	1.097	.745	2.164	1	.141
	OIP5=4	1.005	.764	1.730	1	.188
	OIP5=5	0[a]	.	.	0	.
	OIP6=1	-1.255	.906	1.919	1	.166
	OIP6=2	.136	.815	.028	1	.868
	OIP6=3	-.690	.496	1.936	1	.164
	OIP6=4	-.687	.380	3.272	1	.070***
	OIP6=5	0[a]	.	.	0	.
	OIP7=1	-.686	.664	1.069	1	.301
	OIP7=2	-.799	.618	1.670	1	.196
	OIP7=3	-.427	.526	.658	1	.417
	OIP7=4	-.248	.605	.168	1	.682
	OIP7=5	0[a]	.	.	0	.
	OIP8=1	.821	.691	1.410	1	.235
	OIP8=2	.621	.689	.811	1	.368
	OIP8=3	.717	.578	1.538	1	.215
	OIP8=4	.656	.566	1.341	1	.247
	OIP8=5	0[a]	.	.	0	.
	OIP9=1	-1.349	.739	3.334	1	.068***
	OIP9=2	-.768	.623	1.517	1	.218
	OIP9=3	-.066	.572	.013	1	.908
	OIP9=4	-.159	.515	.096	1	.757
	OIP9=5	0[a]	.	.	0	.
	OIP10=1	-.579	.670	.747	1	.387
	OIP10=2	-.925	.734	1.586	1	.208

	OIP10=3	-1.688	.666	6.436	1	.011**
	OIP10=4	-1.277	.653	3.830	1	.050**
	OIP10=5	0[a]	.	.	0	.
	OIP11=1	.315	.819	.148	1	.700
	OIP11=2	.227	.578	.154	1	.695
	OIP11=3	.929	.490	3.597	1	.058***
	OIP11=4	.279	.489	.326	1	.568
	OIP11=5	0[a]	.	.	0	.
	OIP12=1	.739	.737	1.004	1	.316
	OIP12=2	-.431	.628	.471	1	.493
	OIP12=3	.315	.498	.400	1	.527
	OIP12=4	.267	.418	.408	1	.523
	OIP12=5	0[a]	.	.	0	.

Source: Survey Output

95% significance level and * 90% significance level

Even though the overall regression model is found to be not fit but the some estimates indicate that certain practices such as generation of idea from both the sources, collaboration with Research and Development centers, customers, Intellectual Property Rights purchases, Intellectual Property Rights Trading sell out, and Spin-off may have some influence on firm's Product-sales.

7.1.5 Open Innovation Practices and Firm Performance with reference to More Product Development (MPD)

The open innovation practices such as idea generation through internal and external sources(OIP1), participation in trade shows(OIP7), product development with internal external sources(OIP2), collaboration activities for technology exploration with academic institutions(OIP3), suppliers(OIP4), Research & Development centers(OIP5) and customers(OIP6), Intellectual Property Rights Licensing(OIP8), Intellectual Property Rights purchases(OIP9), Trading Intellectual Property Rights Trading sell out(OIP10), Spin-off(OIP11), and alliance(OIP12) are the independent variables and the more product development is the dependent variable.

The following hypothesis tests the relationship between dependent and independent variables.

H_{03a5}: Practices of Open Innovation approaches do not significantly influence firms to develop more products

H_{A3a5}: Practices of Open Innovation approaches do significantly influence firms to develop more products

To measure the hypothesis, an ordinal logistic regression is estimated between the dependent variable and independent variable.

$$Ln(Y') = \alpha_j - (\beta_1 OIP1 + \beta_2 OIP2 + \beta_3 OIP3 + \beta_4 OIP4 + \beta_5 OIP5 + \beta_6 OIP6 + \beta_7 OIP7 + \beta_8 OIP8 + \beta_9 OIP9 + \beta_{10} OIP10 + \beta_{11} OIP11 + \beta_{12} OIP12) + € \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where β_1, β_2, $\beta_3 \ldots \beta_{12}$ are logit coefficients. When there are j categories, the Proportional Odds model estimates J-1 cut points, and € is the standard error.

Table 7.13 Model Fitting Information Open Innovation approach and More Product Development

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	613.259			
Final	542.044	71.215	48	.016

Source: Survey Output

Table 7.13 discusses the model fit information of the ordinal logistic regression. From the table, it is observed that the p-value is 0.015 and is significant at 95% level. This indicates that the alternate hypothesis H_{A4a5} i.e. Practices of Open Innovation approaches do significantly influence firms to develop more products is not rejected. This means SMEs who are practicing open innovation approach are likely to influence firm to develop more products.

Table 7.14 Pseudo R-Square Open Innovation approach and More Product Development

Pseudo R-Square Method	Pseudo R-Square Value
Cox and Snell	.284
Nagelkerke	.301
McFadden	.115

Source: Survey Output

Table 7.14 provides the pseudo-R-square values. R-square explains the variance among the variables. From the table it can be said that as per Nagelkerke 30.1% variance is explained, Cox and Snell's values explain the variance about 28.4% and as per McFadden the variance among the variables is explained about 11.5%.

Table 7.15 Parameter Estimates of the More Product Development (MPD) and Open Innovation Practices (OIP)

		Estimate	Std. Error	Wald	df	Sig.
Threshold	MPD = 1	-8.940	1.270	49.563	1	.000
	MPD = 2	-7.519	.927	65.809	1	.000
	MPD = 3	-6.659	.847	61.815	1	.000
	MPD = 4	-5.007	.786	40.528	1	.000
	MPD = 5	-4.057	.768	27.877	1	.000
	MPD = 6	-2.167	.731	8.781	1	.003
Location	OIP1=1	19.582	.000	.	1	.
	OIP1=2	-2.115	.924	5.237	1	.022**
	OIP1=3	-.796	.549	2.103	1	.147
	OIP1=4	-.092	.429	.046	1	.830
	OIP1=5	0	.	.	0	.
	OIP2=1	.685	.800	.734	1	.392
	OIP2=2	-.090	.646	.019	1	.889
	OIP2=3	.486	.575	.717	1	.397
	OIP2=4	-.052	.505	.010	1	.919
	OIP2=5	0	.	.	0	.
	OIP3=1	-.606	.668	.825	1	.364
	OIP3=2	-.665	.634	1.101	1	.294
	OIP3=3	-.483	.647	.558	1	.455
	OIP3=4	-1.101	.629	3.067	1	.080***
	OIP3=5	0	.	.	0	.
	OIP4=1	.112	.736	.023	1	.879
	OIP4=2	-.801	.664	1.454	1	.228

	OIP4=3	-.777	.575	1.824	1	.177
	OIP4=4	-.495	.543	.833	1	.362
	OIP4=5	0	.	.	0	.
	OIP5=1	.382	.835	.210	1	.647
	OIP5=2	.311	.811	.147	1	.701
	OIP5=3	.177	.785	.051	1	.821
	OIP5=4	.464	.803	.333	1	.564
	OIP5=5	0	.	.	0	.
	OIP6=1	-1.031	.938	1.209	1	.271
	OIP6=2	-.049	.822	.004	1	.952
	OIP6=3	.062	.510	.015	1	.903
	OIP6=4	.138	.382	.131	1	.717
	OIP6=5	0	.	.	0	.
	OIP7=1	-.854	.672	1.612	1	.204
	OIP7=2	-.445	.619	.517	1	.472
	OIP7=3	-.125	.536	.054	1	.816
	OIP7=4	-.034	.615	.003	1	.956
	OIP7=5	0	.	.	0	.
	OIP8=1	.598	.698	.734	1	.392
	OIP8=2	.307	.697	.194	1	.660
	OIP8=3	.424	.597	.505	1	.477
	OIP8=4	.954	.597	2.553	1	.110
	OIP8=5	0	.	.	0	.
	OIP9=1	-.184	.765	.058	1	.810
	OIP9=2	-.793	.638	1.544	1	.214
	OIP9=3	-.044	.587	.006	1	.940
	OIP9=4	-.939	.535	3.081	1	.079***
	OIP9=5	0	.	.	0	.

	OIP10=1	-.117	.714	.027	1	.870
	OIP10=2	-.604	.771	.613	1	.434
	OIP10=3	-1.025	.702	2.133	1	.144
	OIP10=4	-.720	.690	1.091	1	.296
	OIP10=5	0	.	.	0	.
	OIP11=1	-2.702	.830	10.605	1	.001*
	OIP11=2	-.622	.603	1.063	1	.303
	OIP11=3	-1.036	.508	4.161	1	.041**
	OIP11=4	-.478	.515	.860	1	.354
	OIP11=5	0	.	.	0	.
	OIP12=1	-1.154	.733	2.479	1	.115
	OIP12=2	-.702	.637	1.216	1	.270
	OIP12=3	-.791	.502	2.482	1	.115
	OIP12=4	-.701	.431	2.647	1	.104
	OIP12=5	0	.	.	0	.

Source: Survey Output

* 99% significance level, **95% significance level and *** 90% significance level

From the table 7.15, it is observed that open innovation practices such as idea generation by both internal and external sources (OIP1), collaboration with academic institutes(OIP3), Intellectual Property Rights purchases(OIP9), and Spin-off(OIP11) significantly influences to the firm to develop more products.

SME's, disagreement level decreases compared to strongly agreement for the open innovation practice of generating ideas from both the sources i.e. internal and external. This indicates that firmly is more likely to develop more products if this approach is adopted by the firms.

SME's, agreement with respect to strongly agree decreases for the open innovation practice of collaborations with academic institutes. This indicates that if the firm practices this approach then firm's development of more products is likely to decrease.
SME's, agreement with respect to strongly agree decreases for the open innovation practice of Intellectual Property Rights purchases. This indicates that if the firm practices this approach then firm's development of more products is likely to decrease.
SME's, strongly disagreement level and neutrality decrease compared to strongly agreement for the open innovation practice of spin-off product as an entity. This indicates that firm is more likely to develop more products if this approach is adopted by the firms.

7.2.1 Closed Innovation approaches and its influence on overall Firm Performance

The closed innovation practices such as idea generation through internal sources only (CIP1) and product development with internal sources only (CIP2) are the independent variables, and overall firm performance is the dependent variable.
The following hypothesis tests the relationship between dependent and independent variables.

H_{04a1}: Practices of Closed Innovation approaches do not significantly improve performance of the firm.
H_{A4a1}: Practices of Closed Innovation approaches do significantly improve the performance of the firm.

To measure the hypothesis, an ordinal logistic regression is estimated between the dependent variable and independent variable.

$$Ln(Y') = \alpha_j - (\beta_1 CIP1 + \beta_2 CIP2+) + € \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where β_1, and β_2, are logit coefficients. When there are j categories, the Proportional Odds model estimates J-1 cut points, and € is the error.

Table 7.16 Model Fitting Information Closed Innovation approach and Overall Firm Performance

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	226.139			
Final	204.434	21.705	8	.005

Source: Survey Output

Table 7.16 discusses the model fit information of the ordinal logistic regression. From the table, it is observed that the p-value is 0.005 and is significant at 99% level. This indicates that the alternate hypothesis H_{A4b1} i.e. Practices of Closed Innovation approaches do significantly improve the overall performance of the firm is not rejected. This means SMEs who are practicing closed innovation approach are likely to improve overall firm performance.

Table 7.17 Pseudo R-Square for Closed Innovation approach and Overall Firm Performance

Pseudo R-Square Method	Pseudo R-Square Value
Cox and Snell	.097
Nagelkerke	.103
McFadden	.036

Source: Survey Output

Table 7.17 provides the pseudo-R-square values. R-square explains the variance among the variables. From the table it can be said that as per Nagelkerke 10.3% variance is explained, Cox and Snell's values explain the variance about 9.7% and as per McFadden the variance among the variables is explained about 3.6%.

Table 7.18 Parameter Estimates of Overall Firm Performance (FP) and Closed Innovation Practices (CIP)

		Estimate	Std. Error	Wald	df	Sig.
Threshold	FP = 1	-4.995	1.162	18.487	1	.000
	FP = 2	-3.886	.827	22.061	1	.000
	FP = 3	-3.169	.719	19.422	1	.000
	FP = 4	-1.381	.621	4.940	1	.026
	FP = 5	-.392	.611	.412	1	.521
	FP = 6	1.185	.617	3.693	1	.055
Location	CIP1=1	**1.650**	**.707**	**5.451**	**1**	**.020****
	CIP1=2	**1.661**	**.713**	**5.427**	**1**	**.020****
	CIP1=3	**1.206**	**.706**	**2.918**	**1**	**.088*****
	CIP1=4	.701	.760	.850	1	.357
	CIP1=5	0[a]	.	.	0	.
	CIP2=1	-.486	.539	.813	1	.367
	CIP2=2	**-1.600**	**.460**	**12.094**	**1**	**.001***
	CIP2=3	-.567	.456	1.545	1	.214
	CIP2=4	-.810	.475	2.909	1	.088***
	CIP2=5	0[a]	.	.	0	.

Source: Survey Output

* 99% significance level, **95% significance level and *** 90% significance level

From the table 7.18, it is observed that closed innovation practices such as idea generation by internal sources only(CIP1) and Product development by internal sources only(CIP2) significantly influences overall firm performance.

SME's, strongly disagreement level, disagreement level, and neutrality increase compared to strongly agreement for the closed innovation practice of generating ideas from internal sources only. This indicates that firm is less likely to improve its overall performance of firm if this approach is adopted by the firms.

SME's, disagreement level decreases compared to strongly agreement for the closed innovation practice of developing a product through internal sources only. This indicates that firm is more likely to improve its overall performance of firm if this approach is adopted by the firms.

7.2.2 Closed Innovation approaches and Firm Performance with respect to Market Share

The closed innovation practices such as idea generation through internal sources only (CIP1) and product development with internal sources only (CIP2) are the independent variables, and market share is the dependent variable.

The following hypothesis tests the relationship between dependent and independent variables.

H_{04a2}: Practices of Closed Innovation approaches do not significantly influence the firms' market share

H_{A4a2}: Practices of Closed Innovation approaches do significantly influence the firms' market share

To measure the hypothesis, an ordinal logistic regression is estimated between the dependent variable and independent variable.

$$Ln(Y') = \alpha_j - (\beta_1 CIP1 + \beta_2 CIP2 +) + € \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Where β_1, and β_2, are logit coefficients. When there are j categories, the Proportional Odds model estimates J-1 cut points, and € is the error.

Table 7.19 Model Fitting Information Closed Innovation approach and Market Share

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	227.543			
Final	212.709	14.834	8	.062

Source: Survey Output

Table 7.19 discusses the model fit information of the ordinal logistic regression. From the table, it is observed that the p-value is 0.062 and is significant at 90% level. This indicates that the alternate hypothesis H_{A4b2} i.e. Practices of Closed Innovation approaches do significantly influence firms' market share is not rejected. This means SMEs who are practicing closed innovation approach are likely to influence market share of the firm.

Table 7.20 Pseudo R-Square for Closed Innovation approach and Market Share

Pseudo R-Square Method	Pseudo R-Square Value
Cox and Snell	.067
Nagelkerke	.071
McFadden	.024

Source: Survey Output

Table 7.20 provides the pseudo-R-square values. R-square explains the variance among the variables. From the table it can be said that as per Nagelkerke 7.1% variance is explained, Cox and Snell's values explain the variance about 6.7% and as per McFadden the variance among the variables is explained about 2.4%.

Table 7.21 Parameter Estimate of Market Share and Closed Innovation Practices (CIP)

		Estimate	Std. Error	Wald	df	Sig.
Threshold	MS = 1	-3.235	.816	15.721	1	.000
	MS = 3	-2.366	.690	11.746	1	.001
	MS = 4	-.097	.612	.025	1	.874
	MS = 5	.666	.614	1.177	1	.278
	MS = 6	1.827	.623	8.588	1	.003
Location	CIP1=1	**1.264**	**.695**	**3.309**	**1**	**.069*** **
	CIP1=2	**1.723**	**.707**	**5.937**	**1**	**.015** **
	CIP1=3	1.089	.699	2.425	1	.119
	CIP1=4	.580	.755	.589	1	.443
	CIP1=5	0[a]	.	.	0	.
	CIP2=1	.399	.518	.594	1	.441
	CIP2=2	-.492	.432	1.299	1	.254
	CIP2=3	-.146	.433	.113	1	.737
	CIP2=4	.139	.454	.094	1	.760
	CIP2=5	0[a]	.	.	0	.

Source: Survey Output

95% significance level and * 90% significance level

From the table 7.21, it is observed that closed innovation practices such as idea generation by internal sources only (CIP1) significantly influences firm market share.

SME's, strongly disagreement level, and disagreement level increases compared to strongly agreement for the closed innovation practice of generating ideas internal sources

only. This indicates that firm is likely to decrease its market share if this approach is adopted by the firms.

7.2.3 Closed Innovation approaches and Firm Performance with respect to Revenue

The closed innovation practices such as idea generation through internal sources only (CIP1) and product development with internal sources only (CIP2) are the independent variables and Revenue is the dependent variable.

The following hypothesis tests the relationship between dependent and independent variables.

H_{04a3}: Practices of Closed Innovation approaches do not significantly influence the firm's Revenue

H_{A4a3}: Practices of Closed Innovation approaches do significantly influence the firm's Revenue

To measure the hypothesis, an ordinal logistic regression is estimated between the dependent variable and independent variable.

$Ln(Y') = \alpha_j - (\beta_1 CIP1 + \beta_2 CIP2+) + €$ …….. (1)

Where β_1, and β_2, are logit coefficients. When there are j categories, the Proportional Odds model estimates J-1 cut points, and € is an error.

Table 7.22 Model Fitting Information Closed Innovation approach and Revenue

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	200.272			
Final	188.878	11.394	8	.180

Source: Survey Output

Table 7.22 discusses the model fit information of the ordinal logistic regression. From the table, it is observed that the p-value is 0.180 and is insignificant at 99%, 95%, and 90% level. This indicates that the null hypothesis H_{04b3} i.e. Practices of Closed Innovation approaches do not significantly influence the firm's Revenue is not rejected. This means SMEs who are practicing closed innovation approach; the firm revenue would not be influenced.

Table 7.23 Pseudo R-Square for Closed Innovation approach and Revenue

Pseudo R-Square Method	Pseudo R-Square Value
Cox and Snell	.052
Nagelkerke	.056
McFadden	.019

Source: Survey Output

Table 7.23 provides the pseudo-R-square values. R-square explains the variance among the variables. From the table it can be said that as per Nagelkerke 5.6% variance is explained, Cox and Snell's values explain the variance about 5.2% and as per McFadden the variance among the variables is explained about 1.9%.

Table 7.24 Parameter Estimate of Revenue and Closed Innovation Practices (CIP)

		Estimate	Std. Error	Wald	df	Sig.
Threshold	Revenue = 3	-4.733	1.159	16.666	1	.000
	Revenue = 4	-.456	.615	.548	1	.459
	Revenue = 5	.354	.615	.331	1	.565
	Revenue = 6	1.440	.622	5.360	1	.021
Location	**CIP1=1**	**1.213**	**.700**	**3.001**	**1**	**.083*** **
	CIP1=2	**1.267**	**.707**	**3.206**	**1**	**.073*** **

	CIP1=3	.764	.702	1.184	1	.277
	CIP1=4	.280	.761	.135	1	.713
	CIP1=5	0	.	.	0	.
	CIP2=1	-.257	.515	.249	1	.617
	CIP2=2	-.513	.434	1.396	1	.237
	CIP2=3	-.438	.435	1.014	1	.314
	CIP2=4	.216	.457	.222	1	.637
	CIP2=5	0	.	.	0	.

Source: Survey Output

Even though the model is found not to be fit but the closed innovation practice such as idea generation from internal sources only may likely decrease the firm performance in terms of revenue.

7.2.4 Closed Innovation approaches and Firm Performance with respect to Product Sales

The closed innovation practices such as idea generation through internal sources only (CIP1) and product development with internal sources only (CIP2) are the independent variables, and Product Sales is the dependent variable.

The following hypothesis tests the relationship between dependent and independent variables.

H_{04a4}: Practices of Closed Innovation approaches do not significantly influence the firm's Product Sales

H_{A4a4}: Practices of Closed Innovation approaches do significantly influence the firm's Product Sales

To measure the hypothesis, an ordinal logistic regression is estimated between the dependent variable and independent variable.

$Ln(Y') = \alpha_j - (\beta_1 CIP1 + \beta_2 CIP2+) + €$ …….. (1)

Where β_1, and β_2, are logit coefficients. When there are j categories, the Proportional Odds model estimates J-1 cut points, and € is an error.

Table 7.25 Model Fitting Information Closed Innovation approach and Product Sales

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	197.173			
Final	187.759	9.414	8	.309

Source: Survey Output

Table 7.25 discusses the model fit information of the ordinal logistic regression. From the table, it is observed that the p-value is 0.309 and is insignificant at 99%, 95%, and 90% level. This indicates that the null hypothesis H_{04b4} i.e. Practices of Closed Innovation approaches do not significantly influence the firm's Product Sales is not rejected. This means SMEs who are practicing closed innovation approach, the firm sales of products would not be influenced.

Table 7.26 Pseudo R-Square for Closed Innovation approach and Product Sales

Pseudo R-Square Method	Pseudo R-Square Value
Cox and Snell	0.043
Nagelkerke	0.046
McFadden	0.016

Source: Survey Output

Table 7.26 provides the pseudo-R-square values. R-square explains the variance among the variables. From the table it can be said that as per Nagelkerke 4.6% variance is explained, Cox and Snell's values explain the variance about 4.3% and as per McFadden the variance among the variables is explained about 1.6%.

Table 7.27 Parameter Estimates of Product Sales (PS) and Closed Innovation Practices (CIP)

		Estimate	Std. Error	Wald	df	Sig.
Threshold	FP3 = 2	-4.904	1.161	17.831	1	.000
	FP3 = 4	-.706	.611	1.336	1	.248
	FP3 = 5	.229	.609	.142	1	.707
	FP3 = 6	1.183	.614	3.710	1	.054
Location	CIP1=1	.688	.691	.991	1	.320
	CIP1=2	.927	.700	1.757	1	.185
	CIP1=3	.563	.696	.655	1	.418
	CIP1=4	.011	.755	.000	1	.988
	CIP1=5	0	.	.	0	.
	CIP2=1	.058	.512	.013	1	.910
	CIP2=2	-.336	.431	.608	1	.436
	CIP2=3	-.390	.433	.812	1	.368
	CIP2=4	.447	.457	.958	1	.328
	CIP2=5	0	.	.	0	.

Source: Survey Output

Table 7.27 clearly indicates none of the closed innovation practices significantly influences the product sales of the firm if practiced.

7.2.5 Closed Innovation approaches and Firm Performance with respect to More Product Development

The closed innovation practices such as idea generation through internal sources only (CIP1) and product development with internal sources only (CIP2) are the independent variables, and more product development is the dependent variable.

The following hypothesis tests the relationship between dependent and independent variables.

H_{04a5}: Practices of Closed Innovation approaches do not significantly influence the firms to develop more products

H_{A4a5}: Practices of Closed Innovation approaches do significantly influence the firm to develop more products

To measure the hypothesis, an ordinal logistic regression is estimated between the dependent variable and independent variable.

$Ln(Y') = \alpha_j - (\beta_1 CIP1 + \beta_2 CIP2+) + €$ …….. (1)

Where β_1, and β_2, are logit coefficients. When there are j categories, the Proportional Odds model estimates J-1 cut points, and € is an error.

Table 7.28 Model Fitting Information Closed Innovation approach and More Product Development

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	234.183			
Final	220.392	13.791	8	.087

Source: Survey Output

Table 7.28 discusses the model fit information of the ordinal logistic regression. From the table, it is observed that the p-value is 0.087 and is significant at 90% level. This indicates that the alternate hypothesis H_{A4b5} i.e. Practices of Closed Innovation

approaches do significantly influence the firm to develop more products is not rejected. This means SMEs who are practicing closed innovation approach are likely to have an influence on more product development.

Table 7.29 Pseudo R-Square values Closed Innovation approach and More Product Development

Pseudo R-Square Method	Pseudo R-Square Value
Cox and Snell	0.063
Nagelkerke	0.066
McFadden	0.022

Source: Survey Output

Table 7.29 provides the pseudo-R-square values. R-square explains the variance among the variables. From the table it can be said that as per Nagelkerke 6.6% variance is explained, Cox and Snell's values explain the variance about 6.3% and as per McFadden the variance among the variables is explained about 2.2%.

Table 7.30 Parameter Estimate of More Product Development (MPD) and Closed Innovation Practices (CIP)

		Estimate	Std. Error	Wald	df	Sig.
Threshold	MPD = 1	-6.836	1.222	31.311	1	.000
	MPD = 2	-5.430	.859	40.002	1	.000
	MPD = 3	-4.586	.773	35.246	1	.000
	MPD = 4	-3.043	.715	18.125	1	.000
	MPD = 5	-2.219	.703	9.953	1	.002
	MPD = 6	-.668	.689	.938	1	.333

Location	CIP1=1	-.637	.766	.691	1	.406
	CIP1=2	-.740	.771	.922	1	.337
	CIP1=3	-.598	.770	.603	1	.438
	CIP1=4	-1.243	.823	2.279	1	.131
	CIP1=5	0[a]	.	.	0	.
	CIP2=1	-.090	.534	.028	1	.867
	CIP2=2	**-1.055**	**.448**	**5.553**	**1**	**.018****
	CIP2=3	**-.845**	**.448**	**3.550**	**1**	**.060*****
	CIP2=4	-.721	.467	2.386	1	.122
	CIP2=5	0[a]	.	.	0	.

Source: Survey Output

95% significance level and * 90% significance level

From the table 7.30, it is observed that closed innovation practices such as product development by internal sources only (CIP1) significantly influences the development of more products.

SME's, disagreement level, and neutrality decreases compared to strongly agreement for the closed innovation practice of product development by internal sources only. This indicates that firm is likely to develop more products if this approach is adopted by the firms.

7.3 Inferences

The study results indicate that open innovations practices influences to improve firm performance. The results confirm the results of earlier studies (Chesbrough and Crowther, 2006; Lichtenthaler, 2009; Huang et al., 2010) but differ with the results of Mazzola et al. (2012). The results for the practices of Collaboration as an open innovation practice and its influence on improving overall firm performance are in concurrence with the results of Li et al.(2010) , Qinglan and Yingbiao (2011), Gulshan (2011) and Lee et

al.(2015). The results for the Intellectual Property Rights trading differ with the results of earlier studies (Lichtenthaler, 2011; Kafouros and Forsan, 2012; and Sikimic et al., 2016). The result indicates that for change in Revenue the open innovation practices do not influence. This is in contrast with the results of Lichtenthaler (2011). For the Market Share as a firm performance parameter, the open innovation practices have an influence. The results are in agreement with earlier studies such as Li et al.(2010), Rayyes and Valls-Pasola (2013) and agrees with Lee et al. (2015) only for open innovation practice of collaboration. The results for Product Sales as an indicator for firm performance, none of the open innovation practices do not significantly influence. For the More Product Development as the indicator for firm performance, the open innovation practices such as collaborations, intellectual property purchases, and spin-off influences significantly. This is consistent with results of Inauen and Schenkc-Wicki (2012), Rajala and Westerlund (2012).

For the Closed Innovation practices, the results are significant for Overall Firm Performance, Market Share, and More Product Development and are insignificant for Product Sales and Revenue. The results are consistent with Choi, Lee, and Ham (2016) for More Product Development and with Clausen, Korneliussen and Madsen (2013) for Overall Firm Performance.

7.4 Summary

The chapter discusses the influence of open innovation approach and closed innovation on the performance of the SMEs. The open innovation practices such as idea generation from both internal and external sources, collaborations with academic, R&D institutes and customers, and spin-off have a significant influence on firm performance. Whereas practices such product development with the help of external sources along with internal sources, collaborations with suppliers, intellectual property purchases, licensing and sellout , and alliances may not influence the firm performance. Among the closed innovation approaches, idea generation through internal sources may negatively influence

firm performance and product development through internal sources has a significant positive influence on firm performance.

Chapter 8
Findings and Discussion

8.1 Introduction

This chapter discusses the findings of the results, compares the study results with the previous researchers results and its implication for managrial decision.

8.2 Summary of Major Findings

The major findings of the study are:

1. Firms are aware of both the innovation approaches to a large extent.
2. The majority of the firms adopt both the innovation approaches.
3. Adoption of Open innovation approach is more than closed innovation approach by the firms.
4. Age of the firm differs in the adoption of innovation approaches.
5. Firm size does not differ in the adoption of innovation approach.
6. Entrepreneur's experience in current firm differs in the adoption of innovation.
7. Firm's year of establishment and adoption of innovation differs.
8. Firm's based on their investment made, type of ownership and type of product do not differ in the adoption of innovation approach.
9. Firms generally invest 25-30% of their annual budget for their R &D activities.
10. More 50% of the firms have Intellectual Property Rights from their R & D activities.
11. Firms funding pattern do not differ in the adoption of innovation approach.
12. The firms who own IPR from their R & D activities differ in their adoption of innovation approach.
13. The motivating factor in adopting an innovation is to become a market leader, customer satisfaction and competition.
14. Government policies slightly motivate firms to adopt an innovation.

15. The time factor is the major challenge to adopt and practice innovation, and the availability of funds is also the challenge for firms to adopt and practice innovation.
16. There is a positive association between awareness of innovation approach and its adoption.
17. Internal factors of the firm alone influence firm to adopt an innovation and external factors alone do not influence the firms to adopt an innovation.
18. The internal factors alone that influence the firm to adopt open innovation as compared to adoption both the approaches are Firm age, Firm size, Education level, Experience of the decision maker, the culture of the firm.
19. The internal factors alone that influence the firm to adopt closed innovation compared to the adoption of both the approaches are Firm Age, Firm Size, Experience of the decision maker, the culture of the firm and to an extent the emphasis on R&D.
20. The external factors alone may not influence the SMEs to adopt any innovation approach. But ecosystem may influence in the adoption of innovation approach.
21. When both the factors are considered, the firm level factors such as age, size, education, experience, emphasis on R & D and culture of the firm influence to adopt open innovation as compared to both the practices. Whereas external factors such as such as competition, customers, ecosystem and technological advances influence firm to adopt open innovation as compared to both the approaches.
22. Together both firm-level factors and external factors to the SMEs do not influence to adopt closed innovation as compared to both the approaches.
23. The open innovation practices such as idea generation from both internal and external sources, collaborations with academic, R&D institutes and customers, and spin-off have a significant influence on firm performance.
24. Among the closed innovation approaches, idea generation through internal sources influence firm performance.

25. Product development through internal sources has a significant positive influence on firm performance.
26. Open innovation practices such as idea generation by both internal and external sources, collaboration with academic institutes, Intellectual Property Rights purchases, and Spin-off significantly influences to the firm to develop more products.
27. Open innovation practices such as idea generation by both internal and external sources significantly influence to improve the market share performance.
28. Open innovation practices such as idea generation by both internal and external sources, collaboration with academic institutes, collaboration with R&D institutes, collaboration with the customer, Spin-off, and alliance significantly influences to improve the overall firm performance.

8.3 Discussion

8.3.1 Motivation and Challenges to adopt Innovation

The study results indicate that there are certain factors that motivates SMEs to adopt innovation. The results indicate that major factor that motivates SMES to adopt innovation is to be a market leader. The study results confirm with the result of earlier researchers(Van de Vrande et al., 2009; Chesbrough and Crowther, 2006; Birkle and Gewald, 2013). Results also indicate that Customer satisfaction is another factor that motivates SMEs to adopt innovation. These results are in concurrence with the findings of earlier researcher (Hakkim and Heidrik, 2008; Van de Vrande et al., 2009). Further results suggest that Competition also motivates the SMEs to adopt innovation. But this factor is very less motivator as compared to other two factors. Government Policies do motivates the SMEs to a very small extent. This is in concurrence with the works of Abulrub and Lee (2012) and Hakkim and Heidrik (2008).

The study found that employee resistance, non-co-operation and time are the major challenges for the software SMEs to adopt innovation. The study results i.e. employee

resistance and non co-operation among decision maker are in concurrence with the results of earlier researcher (Rodriguez and Lorenzo, 2011; Sondergaard, Knudsen and Burcharth, 2011; Rayyes and Valls-Pasola, 2013). Another interesting finding is that many decision makers opined that time factor is an important barrier to adopt innovation.

8.3.2 Firm-level factors and Adoption of Innovation approach.

The result shows that age of the firm negatively influences the adoption of open innovation and closed innovation independently compared to the adoption of both the approaches. This indicates that as the age of the firm increases firms prefer to adopt both the approaches. The results concur with the results of Mazzola et al. (2012) and Mina et al. (2014).

The results with respect to the size of firm and adoption of open innovation and closed innovation indicate that size of the firm negatively influences the adoption of open innovation and closed innovation independently compared to both approaches. This indicates that firm believes that as the size increases they prefer to adopt a combination of both open and closed innovation approach than open innovation or closed innovation in a silo. The results concur with the results of Mazzola et al. (2012) but differ with earlier researchers (Lichtenthaler, 2008; Gumus and Cubuku, 2011; Abulrub and Lee, 2012; and Mina et al., 2014).

The education qualification of the decision maker of SMEs significantly influences the adoption of innovation. The results agree with the study of Bayarcelik, Tasel, and Apak (2014) but their influence differs considerably as adoption of the open approach, they influence negatively and for closed innovation positively.

The experience of decision maker significantly influences the adoption of innovation. For adoption of open approach they influence positively and for closed innovation negatively.

The firm culture has an influence on adoption on open innovation and closed innovation independently. The results agree with the study of Roper (1997), Chen et al. (2008), Gumus and Cubukcu (2011), Mbizi et al.(2013), Bayarcelik, Tasel and Apak (2014).

The results indicate that investment in R & D in SMEs is not a significant influencing factor in adopting an open innovation. The results differ with the earlier studies (Chen and Chen, 2005; Yifeng, 2011; Bianchi et al., 2016) whereas the investment in R&D influences SMEs to adopt closed innovation. Hence it could be said that investment in R&D influences adoption of innovation (Ren et al., 2015; Chen and Chen, 2005; Yifeng, 2011; Bianchi et al. 2016).

8.3.4 External factors and Adoption of Innovation

The results indicate that external factors such as competition and ecosystem influence SMEs to adopt an innovation. Competition positively influences SMEs to adopt open innovation and adopt closed innovation whereas ecosystem negatively influences SMEs to adopt open innovation and positively to adopt closed innovation. These results concur with the results of Nicita et al. (2005) and Masson (2013). Whereas other external factors such as customers, government policies, and technological advancements do not significantly influence SMEs to adopt an innovation. These results are contradicting the results of earlier researchers (Ghafele and O'Brien, 2013; Wynarczyk, 2013; Hamdani and Wirawan, 2012; Gourova and Toteva, 2012; De Massis et al., 2011; Cooke and Wills, 1999; Krapex, Skerlavaj, and Groznik, 2012). Thus it can be said only competition, and local ecosystem influences the SMEs in Indian Software Product segment to adopt an innovation.

8.3.5 Firm Level and External factors influence on Adoption of Innovation

The study results indicate that firm age negatively influences the adoption of open innovation approach compared to both approaches. The result is in concurrence with the results of Mazzola et al. (2012) and Mina et al. (2014). The result also indicates that firm age influences the adoption of open innovation and do not influence to adopt closed innovation approach.

The study result confirms the results of Mazzola et al. (2012) for size as an important factor for adoption of innovation. However, the study results disagrees with the results of

Lichtenthaler (2008), Abulrub and Lee (2012), Mina et al. (2014), and Ren et al. (2015). The results also indicate that size of the firm negatively influences the adoption of open innovation approach and do not influence to adopt closed innovation approach. Thus indicating that as the size(Headcount) increases firm tends slow down the adoption of open innovation approach.

The education qualification of the decision maker of SMEs significantly influences the adoption of innovation. The results agree with the study of Bayarcelik, Tasel, and Apak (2014) but their influence differs considerably. For adoption of open approach, they influence negatively and do not influence to adopt closed innovation approach.

The experience of decision maker significantly influences the adoption of innovation. For adoption of the open approach, they influence positively and do not influence to adopt closed innovation approach.

The firm culture has an influence on adoption on open innovation and but do not influence to adopt closed innovation. The results agree with the study of Roper (1997), Chen et al. (2008), Gumus and Cubukcu (2011), Mbizi et al.(2013), Bayarcelik, Tasel and Apak (2014).

The results indicate that investment in R & D in SMEs is not a significant influencing factor in adopting open innovation and closed innovation. The results differ with the earlier studies (Chen and Chen, 2005; Yifeng, 2011; Bianchi et al., 2016)

With respect to external factor competition, the result indicates that competition influences SMEs to adopt open innovation compared to both the approaches. These results are in consistent with results of Nicita et al. (2005) and Aminullah and Adnan (2012).

Customers influence SMEs positively to adopt open innovation compared to both the approaches whereas to adopt closed innovation customers do not influence. These results are inconsistent with the results of Klewitz and Hansen (2013).

Ecosystem negatively influences SMEs to adopt open innovation and do not influences to adopt closed innovation. These results concur with the results of Nicita et al. (2005) and Masson (2013).

Government policies do not significantly influence SMEs to adopt any innovation approach. These results are contradicting the results of earlier researchers (Hakkim and Heidrick, 2008; Ghafele and O'Brien, 2013; Wynarczyk, 2013; Hamdani and Wirawan, 2012; Cooke and Wills, 1999; Krapex, Skerlavaj and Groznik, 2012).

Technological advances will influence the SMEs to adopt open innovation approaches compared to both the approaches but do not influence to adopt closed innovation approach compared to both the approaches. The results differ with the results of earlier researchers (Wynarczyk, 2013; Gourova and Toteva, 2012; Bayarcelik, Tasel and Apak, 2014).

8.3.6 Open Innovation practices and Firm Performance

The study suggests that open innovations practices influences to improve firm performance. The results confirm the results of earlier studies (Chesbrough and Crowther, 2006; Lichtenthaler, 2009; Huang et al., 2010) but differ with the results of Mazzola et al. (2012). The results for the practices of Collaboration as an open innovation practice and its influence on improving overall firm performance are in concurrence with the results of Li et al.(2010) , Qinglan and Yingbiao (2011), Gulshan (2011) and Lee et al.(2015). The results for the Intellectual Property Rights trading differ with the results of earlier studies (Lichtenthaler, 2011; Kafouros and Forsan, 2012; and Sikimic et al., 2016). The result is a pointer for change in Revenue the open innovation practices do not influence. This is in contrast with the results of Lichtenthaler (2011). For the Market Share as a firm performance parameter, the open innovation practices have an influence. The results are in agreement with earlier studies such as Li et al.(2010), Rayyes and Valls-Pasola (2013) and agrees with Lee et al. (2015) only for open innovation practice of collaboration. The results for Product Sales as an indicator for firm performance, none of the open innovation practices do not significantly influence. For the More Product Development as the indicator for firm performance, the open innovation practices such as collaborations, intellectual property purchases, and spin-off influences significantly. This

is consistent with results of Inauen and Schenkc-Wicki (2012), Rajala and Westerlund (2012).

8.3.7 Closed Innovation practices and Firm Performances

For the Closed Innovation practices, the results are significant for Overall Firm Performance, Market Share, and More Product Development and are insignificant for Product Sales and Revenue. The results are consistent with Choi, Lee, and Ham (2016) for More Product Development and with Clausen, Korneliussen and Madsen (2013) for Overall Firm Performance. This indicates that the firms who are adopting and practices closed innovation approaches even though there are able to develop more products but are unable to boost their sales of the product developed and enhance the firm's revenue.

8.4 Managerial Implications

The results of the study have implications on the practicing manager and decision makers of technological firms in the SME segment. The adoption of innovation approach has to be carefully selected considering the markets and domain of the business. No single innovation approach is suited for SMEs in the Indian context of Software product segment due to changing business and technological requirements. The SMEs have to strategically choose a combination of open innovation practices and closed innovation practices for the better performance of the firm. The open innovation practices such collaboration with various partners and alliances should be carefully selected and should be of strategic importance to the company. Managers should carefully evaluate both the open innovation and closed innovation practices and must opt for a combination of open innovation and closed innovation practices for both idea generation and product development. Practices such as Spin-offs and trading of IPR are very nascent in the context of Indian technological SMEs and SMEs should carefully adopt these practices.

8.5 Summary

The adoption of innovation approaches by SMEs and the factors influencing them are discussed in three different ways. The influence of firm-level factors alone is taken into consideration for the adoption of innovation approach; it is found that Firm age, Firm size, Education level, Experience of the decision maker, the culture of the firm influences the SMEs to adopt open innovation as compared to adoption both the approaches. Further Firm Age, Firm Size, Experience of the decision maker, the culture of the firm and to an extent the emphasis on R&D influences SMEs to adopt closed innovation compared to the adoption of both the approaches.

When only Firm external factors are considered, factors such as competition, and Eco System has influence to adopt both approaches compared to open approaches and closed whereas customers, Government Policies, and Technological Advances do not influence the SMEs to adopt open innovation or closed innovation approach compared to both the approaches.

When both the firm level factors and external factors together are considered, it is found that these factors only influence the SMEs to adopt open innovation but not closed innovation. The factors that influence the SMEs to adopt an open innovation are Firm Age, Firm Size, and Experience of the decision maker, Education of the decision maker, certain cultural factors, Competition, Customer, Eco-system and technological advances.

The chapter also discuss the influence of open innovation approach and closed innovation on the performance of the SMEs. The open innovation practices such as idea generation from both internal and external sources, collaborations with academic, R&D institutes and customers, and spin-off have a significant influence on firm performance. Whereas practices such product development with the help of external sources along with internal sources, collaborations with suppliers, intellectual property purchases, licensing and sellout, and alliances may not influence the firm performance. Among the closed innovation approaches, idea generation through internal sources may negatively influence firm performance and product development through internal sources has a significant positive influence on firm performance.

Further, the chapter also summaries the findings of the study and discuss the study results with previous results and provides an insight for managerial decisions.

Chapter 9
Conclusion of the Study

9.1 Introduction

In India too, the SMEs play a pivotal role in the overall industrial economy of the country. Innovation fuels the growth of SMEs. The software industry has been in the forefront in adopting innovative approach and practices for its product development and other engagements. The Indian software industry comprises of small and medium firms largely. In the last five years, India has seen a tremendous increase in the number of startups in the product space. Innovation is core practice among these firms, and only the approach of innovation is different. Some have adopted open innovation approach, some have adopted closed innovation approach, and some have adopted both open and closed approach. Hence this study gained importance to know which of the innovation approaches are more adopted and practiced among the software product SMEs. Thus the study focused on examining the factors that influence these SMEs to adopt certain innovation approach, the influence of the open innovation approach and closed innovation approach on the performance of the firm.

Chapter 1 introduced the SMEs, role of SME in building the economy, innovation, and the chapter scheme. Chapter 2 reviewed the relevant literature on factors influencing the firms to adopt innovation i.e. influence of internal factors and external factors, innovation practices and innovation practices and firm performance. The chapter helps in identifying the research gap of the study. Chapter 3 has described the problem statement, conceptual framework, research questions, research objectives and hypothesis development. Chapter 4 describes the research approach, sampling plan, instrument development (Questionnaire Development) and statistical tools that are used to analyze the dataset. Chapter 5 provides and describes the profile of SMEs and its respondents. Respondents profile in terms respondent age, designation, education profile, marital status, gender, work experience details. The SMEs profile includes Age of the firm, Size of the firm, Year of the establishment, Ownership pattern, funding type, markets served, the investment made, R

& D investment, Products owned by the firm, IPR owned by the firm is described. The factors that motivate to adopt innovation and challenges faced in the adoption of innovation are identified. The awareness of SMEs with respect to innovation, adoption with respect to innovation and also the association between awareness of innovation approach and its adoption among the SMEs.

The chapter 6 examined the factors that influence the SMEs to adopt open innovation approach, closed innovation approach or both. The factors may be internal to the firm or external to the firm or combination of both internal and external. The chapter 7 discussed the open innovation and closed innovation practices of SMEs and its influence on firm performance. The open innovation practices such as idea generation through external sources, participation in trade shows, product development with external agents, collaboration activities for technology exploration with academic institutions, suppliers, Research & Development centers and customers, Spin-off and Intellectual Property Rights Trading are practiced by SMEs. The closed innovation practices such as idea generation through internal sources and product development with the help of internal resources only are practiced by SMEs. The extent of influence of these practices on firm performance with respect to overall, change in market share, change in revenue, change in product sales and able to come up with more products is examined.

The chapter 8 provides the insights towards the study findings and discuss the results with the findings of the earlier study.

This chapter discusses the major findings of the study, the conclusion of the study, policy suggestion on the promotion of Innovation, limitation of the study and scope for the future research.

9.2 Conclusion of the study

SMEs in the software product segment adopt both open innovation approach and closed innovation approach for better firm performance. There are certain internal factors and external factors which influence software product SMEs to adopt certain innovation approach. When only influence of internal factors are considered, then the study found

that factors such as firm age, firm size, education level, experience of the decision maker, culture of the firm influences the SMEs to adopt open innovation approach as compared to adoption both the approaches and Firm Age, Firm Size, Experience of the decision maker, culture of the firm and to an extent the emphasis on R&D influences SMEs to adopt closed innovation approach compared to of both the approaches. When only Firm external factors are considered, factors such as competition, and Eco System has influence to adopt both approaches compared to closed approaches whereas customers, Government Policies, and Technological Advances do not influence the SMEs to adopt open innovation or closed innovation approach compared to both the approaches.

SMEs which adopt open innovation approach and practices idea generation by both internal and external sources, collaboration with academic institutes, collaboration with R&D institutes, collaboration with the customer, Spin-off, and alliance have found that their overall performance improves.

The SMEs can improve their market share by practicing open innovation practices such as idea generation by both internal and external sources.

SMEs are able to develop more products if they practice the open innovation practices such as open innovation practices such as idea generation by both internal and external sources, collaboration with academic institutes, Intellectual Property Rights purchases, and Spin-off.

SMEs adoption of closed practices such as practices such as idea generation by internal sources only and Product development by internal sources only helps the firms to improve firm performance. Closed innovation practices such as idea generation by internal sources only help the SMEs to enhance firm market share. Closed innovation practices such as product development by internal sources only help SMEs in the development of more products.

Overall SMEs which adopts a mix of open and closed innovation approach is helping to improve the firm performance.

9.3 Policy Suggestion for the Promotion of Innovation

In the current scenario, the government policies are not having an influence on the innovation approach adopted by the SMEs. There is an intervention needed by the government in the promotion of innovation among the SMEs. SMEs feel that if the government can provide a dynamic ecosystem that will help the SMEs in their thought process. SMEs feel that lack of funds is the major reason for not being innovative. The government can propose to provide funds for those SMEs who are being innovative and who have developed innovative product or service for solving the major societal problem. Also, Government can propose tax sops for the companies who provide innovative solutions. The government should propose a comprehensive tax structure that can help the companies to save funds for their innovation. Government technological projects which are undertaken by technical institutes should have an industry collaborating partner. This would help to bridge the gap between academic and industry interaction.

9.4 Contribution of the study

This study contributes to the academic knowledge of innovation and SMEs. The study provides a dimension in the selection of innovation approaches and practices for the technological SMEs. The factors influencing SMEs to adopt innovation has been studied extensively, but a gap was there with respect to external factors influence on adoption of innovation. The study has addressed this issue. Also, the innovation approaches that have been adopted by technological SMEs in India has been addressed, and study attempts to fill the gap to compare the both open innovation approach and closed innovation adopted by technological SMEs and its influence on firm performance.

9.5 Limitations of the study

A number of limitations need to be considered. Firstly, the study findings are not generalizable to the entire population of Indian Software SMEs. Nevertheless, the study findings are applicable to Software product SMEs in Karnataka. Secondly, the present study was able to analyze the change in firm performance only not the actual

performance. The third limitation was that the study was limited only to the ecosystem of Bangalore.

9.6 Future Research Work

This study has thrown up many questions in need of further investigation. It is recommended that more research is undertaken in the following areas:

1. Is there any difference in adoption of Innovation Approach among Software Product firms across different eco-system need to be studied?
2. A comparison about Inbound Open innovation and Outbound Innovation on firm Performance can be undertaken.
3. Influence of leadership style on adoption of Innovation practices across SMEs needs to be studied.
4. Adoption of open innovation practices among SMEs of different sectors- A comparison can be carried out.
5. The role of the Government in the development of ecosystems for vibrant innovation practices can be attempted.
6. The impact of institutions such as CII, FKCCI & and such institutions on strengthening firms can be a theme of research.
7. There is a need to study temporal effects of long survival institutions under family type or otherwise.

APPENDIX I

RESEARCH INSTRUMENT

Questionnaire on

Innovation Approaches, Practices, and Firm Performance among select Software Product SMEs: A case of Bangalore Firms

Dear Sir/Madam,

I am Sumukh S. Hungund, research scholar currently pursuing doctoral studies in School of Management at National Institute of Technology Karnataka, Surathkal under the supervision of Prof. K. B. Kiran. My research area is **Innovation,** and my research topic is on **"Innovation Approaches, Practices, and Firm Performance among select SMEs: A case of Select Software Product firms of Bangalore."** I kindly request you to spare your valuable time in filling the responses. The responses collected will be kept strictly confidential and will be used only for academic purpose.

Thanking you

Sumukh S. Hungund

Research Scholar

NITK Surathkal

General Questions

1. Name of the respondent (Optional):

2. Organization Name :

3. Age of the respondent
   (a) 25-30 (b) 31-35 (c) 36-40 (d) 41-45 (e) 46-50 (f) Above 50

4. Designation of the respondent

(a) CEO/MD/President (b) CTO/VP-Eng./VP-Technology (c) Co-founders (d) Product Heads

5. Educational Qualification
   (a) Bachelor's Degree (b) Master's (c) Doctoral (d) Others

6. Type of Education
   (a) Technical (b) Non-Technical

7. Gender
   (a) Male (b) Female

8. Marital Status
   (a) Single (b) Married

9. Total work experience
   (a) Less than 5 (b) 6-10 (c) 11-15 (d) 16-20 (e) Above 20

10. Years of experience in SME:
    (a) Less than 5 (b) 6-10 (c) 11-15 (d) 16-20 (e) Above 20

11. Years of experience in current organization

(a) Less than 5 (b) 6-10 (c) 11-15 (d) 16-20 (e) Above 20

12. Previous Industrial Experience is in

(a) SME only (b) MNCs only (c) R & D Labs only (g) All the three

13. Year of Establishment of the current firm: ……..

14. Type of ownership of firm

(a) Proprietary firm (b) Partnership firm (c) Private Ltd. Firm

15. Type of firm

(a)Product only (b) Product and Services (c) Product as Service (SaS)

16. Funding pattern of my firm

(a) Fully Self-funded (b) Self-Funded and Angel Investor (c) Fully Funded by VC's

Firm Level Factors and External Factors

1. Age of your firm in years

(a) 0-5 (b) 6-10 (c) 11-15 (d) 16-20 (e) more than 20

2. Size of the firm

(a) 0-10 (b) 11-20 (c) 21-30 (d) 31-40 (e) 41-50 (f) 51-100 (g) 101-250

3. Initial Investment made in Lakhs

(a) Less than 25 (b) 26-50 (c) 51- 75 (d) 76-100 (e) above 100

4. Break even achieved in

(a) Still not achieved (a) 1-3 years (b) 4-6 years (c) 7-10 year

5. Where do you serve your products?

(a) Domestic Market Only (b) Global Market only (c) Both

6. How many products does your firm own?

(a) 1-3 (b) 4-6 (c) 7-9 (d) more than 10

7. What factors do you think will influence to adopt innovation?

(a) Firm Internal Factors only (b) Firm external Factors only (c) Both

8. Competition in the market influences your firm to adopt Innovation practices

(a) Strongly Disagree (b) Disagree (c) Neither Agree nor Disagree (d) Agree (e) Strongly agree

9. Age of the firm influences the firm to adopt Innovation practices

(a) Strongly Disagree (b) Disagree (c) Neither Agree nor Disagree (d) Agree (e) Strongly Agree

10. Size of the firm influences the firm to adopt Innovation practices

(a) Strongly Disagree (b) Disagree (c) Neither Agree nor Disagree (d) Agree (e) Strongly Agree

11. Education Qualification of entrepreneur influences the firm to adopt Innovation practices

(a) Strongly Disagree (b) Disagree (c) Neither Agree nor Disagree (d) Agree (e) Strongly Agree

12. Experiences of the entrepreneur influences to adopt Innovation practices

(a) Strongly Disagree (b) Disagree (c) Neither Agree nor Disagree (d) Agree (e) Strongly Agree

13. Voice of the customer influence us to adopt Innovation practices

(a) Strongly Disagree (b) Disagree (c) Neither Agree nor Disagree (d) Agree (e) Strongly Agree

14. Industry eco-system will influence us to adopt Innovation practices

(a) Strongly Disagree (b) Disagree (c) Neither Agree nor Disagree (d) Agree (e) Strongly Agree

15. Policies of government influences us to adopt innovation practices

(a) Strongly Disagree (b) Disagree (c) Neither Agree nor Disagree (d) Agree (e) Strongly Agree

16. Technological advances influence us to adopt innovation practices

(a) Strongly Disagree (b) Disagree (c) Neither Agree nor Disagree (d) Agree (e) Strongly Agree

17. Competition drives us to adopt Innovation practices

(a)Strongly Disagree (b) Disagree (c) Neither Agree nor Disagree (d) Agree (e) Strongly Agree

18. Our Employees are the driving force to adopt Innovation practices in our firm

(a) Strongly Disagree (b) Disagree (c) Neither Agree nor Disagree (d) Agree (e) Strongly Agree

19. Innovation proposals are welcomed in our firm

(a) Strongly Disagree (b) Disagree (c) Neither Agree nor Disagree (d) Agree (e) Strongly Agree

20. Innovation practices are perceived as too risky in our firm

(a) Strongly Disagree (b) Disagree (c) Neither Agree nor Disagree (d) Agree (e) Strongly Agree

21. In our firm, we seek innovative ideas from our internal sources only

(a) Strongly Disagree (b) Disagree (c) Neither Agree nor Disagree (d) Agree (e) Strongly Agree

22. In our firm, we are keen on sourcing ideas from external sources also

(a) Strongly Disagree (b) Disagree (c) Neither Agree nor Disagree (d) Agree (e) Strongly Agree

23. We promote innovative ideas in our firm

(a)Strongly Disagree (b) Disagree (c) Neither Agree nor Disagree (d) Agree (e) Strongly Agree

24. We support innovative ideas in our firm

(a) Strongly Disagree (b) Disagree (c) Neither Agree nor Disagree (d) Agree (e) Strongly Agree

25. In our firm, Employees are rewarded for proposing new ideas

(a) Strongly Disagree (b) Disagree (c) Neither Agree nor Disagree (d) Agree (e) Strongly Agree

26. In our firm, Employees are not hesitant to speak about new idea for better performance

(a) Strongly Disagree (b) Disagree (c) Neither Agree nor Disagree (d) Agree (e) Strongly Agree

27. In our firm ,Employees are not penalized if the new ideas proposed do not work

(a) Strongly Disagree (b) Disagree (c) Neither Agree nor Disagree (d) Agree (e) Strongly Agree

28. In our firm, we give more emphasis on Research & Development activities

(a)Strongly Disagree (b) Disagree (c) Neither Agree nor Disagree (d) Agree (e) Strongly Agree

29. We do make substantial investment for Research & Development activities

(a)Strongly Disagree (b) Disagree (c) Neither Agree nor Disagree (d) Agree (e) Strongly Agree

30. Our Research & Development investment annually is_____% of annual budget

(a) 0-10 (b) 11-20 (c) 21-30 (d) 31-50 (e) More than 50

31. Does your firm own any Intellectual Property Rights from your R & D activities

(a) Yes (b) No

32. What motivates the firm to adopt innovation practices?

(a) To be the market leader (b) To satisfy customer (c) competition (d) Govt.Policies (e) All the four (e)No Motivation (f) None of these

33. What challenges do you face while adopting innovation practices?

(a) Employees resistance (b) Non-co-operation from Top brass (c) Time factor (d) All the three (e) No challenges (f) None of these

Innovation Approaches & Practices

1. I believe in the concept of Innovation

(a) Strongly Disagree (b) Disagree (c) Neither Agree nor Disagree (d) Agree (e) Strongly Agree

2. I practice innovation in my firm

(a) Strongly Disagree (b) Disagree (c) Neither Agree nor Disagree (d) Agree (e) Strongly Agree

3. I am aware of the term

(a) Open Innovation (b) Closed Innovation (c) Both

4. I have adopted in my firm the practices of

(a) Open Innovation (b) Closed Innovation (c) Both

5. Given the definition of Open Innovation as purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively to what extent do you concur with it

(a) Strongly Disagree (b) Disagree (c) Neither Agree nor Disagree (d) Agree (e) Strongly Agree

6. Open Innovation practices involve Collaborations, Intellectual Property Licensing –in and Licensing out, Alliances and Spin-off. Which of these practices you have adopted in your firm

(a) Collaborations (b) Intellectual Property Licensing-in (c) Intellectual Property Licensing-out (d) Alliances (e) Spin-offs (f) All of them

7. Given the definition of Closed Innovation, as extensive use of only internal resources and knowledge to generate an idea, develop a product to create, capture and sustain in the market. To what extent do you concur with it

(a) Strongly Disagree (b) Disagree (c) Neither Agree nor Disagree (d) Agree (e) Strongly Agree

8. I believe that Firm should hire the best and smartest people

(a) Strongly Disagree (b) Disagree (c) Neither Agree nor Disagree (d) Agree (e) Strongly Agree

9. I believe that A firm need not employ all smart people but rather work with them inside and outside the firm

(a) Strongly Disagree (b) Disagree (c) Neither Agree nor Disagree (d) Agree (e) Strongly Agree

10. We generate ideas from our internal sources only

(a) Strongly Disagree (b) Disagree (c) Neither Agree nor Disagree (d) Agree (e) Strongly Agree

11. We generate ideas with the help of internal and external sources

(a) Strongly Disagree (b) Disagree (c) Neither Agree nor Disagree (d) Agree (e) Strongly Agree

12. We develop our product line through internal R & D only

(a) Strongly Disagree (b) Disagree (c) neither Agree nor Disagree (d) Agree (e) Strongly Agree

13. We develop our product line through internal R&D team and external collaborators

(a) Strongly Disagree (b) Disagree (c) Neither Agree nor Disagree (d) Agree (e) Strongly Agree

14. We collaborate with Academic Institutions for Innovation activity

(a) Strongly Disagree (b) Disagree (c) Neither Agree nor Disagree (d) Agree (e) Strongly Agree

15. We collaborate with our suppliers for Innovation activity

(b) Strongly Disagree (b) Disagree (c) Neither Agree nor Disagree (d) Agree (e) Strongly Agree

16. We collaborate with R&D labs for Innovation activity

(a) Strongly Disagree (b) Disagree (c) Neither Agree nor Disagree (d) Agree (e) Strongly Agree

17. We collaborate with our customers for Innovation activity

(a) Strongly Disagree (b) Disagree (c) neither Agree nor Disagree (d) Agree (e) Strongly Agree

18. We participate in innovation trade shows for idea generation

(a) Strongly Disagree (b) Disagree (c) neither Agree nor Disagree (d) Agree (e) Strongly Agree

19. We are ready to license out our unused Intellectual Property Rights to the third party

(a) Strongly Disagree (b) Disagree (c) neither Agree nor Disagree (d) Agree (e) Strongly Agree

20. We are ready to purchase third party's Intellectual Property Rights for our product development

(a) Strongly Disagree (b) Disagree (c) neither Agree nor Disagree (d) Agree (e) Strongly Agree

21. We are ready to sell out our Intellectual Property Rights to the third party

(a) Strongly Disagree (b) Disagree (c) neither Agree nor Disagree (d) Agree (e) Strongly Agree

22. We prefer to have an alliance for new product development

(a) Strongly Disagree (b) Disagree (c) neither Agree nor Disagree (d) Agree (e) Strongly Agree

23. We are ready to spin –off our product as a firm to attract new market

(a) Strongly Disagree (b) Disagree (c) neither Agree nor Disagree (d) Agree (e) Strongly Agree

Firm Performance

1. Adoption of Innovation approaches impacts firm's performance

(a) Strongly Disagree (b) Disagree (c) somewhat Disagree (d) Neither Agree nor Disagree (e) somewhat Agree (f) Agree (g) Strongly Agree

2. After adoption of Innovation approach, our firm performance has improved

(a) Strongly Disagree (b) Disagree (c) somewhat Disagree (d) Neither Agree nor Disagree (e) somewhat Agree (f) Agree (g) strongly Agree

3. After adoption of Innovation approach our firm market share has

(a) Decreased Strongly (>10%) (b) Decreased Moderately (5-10%) (c) Decreased Marginally (< 5%) (d) Neither decrease nor Increase (e) Increased marginally (< 5%) (f) Increased Moderately (5-10%) (g) Increased Strongly (> 10%)

4. After adoption of Innovation approach our firm revenue has

(a) Decreased Strongly (>10%) (b) Decreased Moderately (5-10%) (c) Decreased Marginally (< 5%) (d)Neither decrease nor Increase (e) Increased marginally (< 5%) (f) Increased Moderately (5-10%) (g) Increased Strongly (> 10%)

5. After adoption of Innovation approach our product sales has

(a) Decreased Strongly (>10%) (b) Decreased Moderately (5-10%) (c) Decreased Marginally (< 5%) (d) Neither decrease nor Increase (e) Increased marginally (< 5%) (f) Increased Moderately (5-10%) (g)Increased Strongly (>10%)

6. After adoption of Innovation approach, Firm is able to come up with more products

(a) Strongly Agree (b) somewhat Agree (c) Agree (d) Neither Agree nor Disagree (e) somewhat Disagree (f) Disagree (g) Strongly Disagree

APPENDIX II

LIST OF THEORIES

- Chesbrough H (2003). “The era of open innovation”.
- Gassmann O (2006). “Opening up the innovation process: towards an agenda.”
- Gassmann O and Enkel E (2004). “Towards a Theory of Open Innovation: Three Core Process Archetypes”.
- Chesbrough, H.,and Schwartz, K. (2007). “Innovating Business Models with Co-Development Partnerships.”
- Lichtenthaler, U., and Ernst, H., (2008). “Opening up the innovation process: the role of technology aggressiveness.”
- Lichtenthaler, U. (2009). “Absorptive Capacity, environmental turbulence and complementary of organizational learning process.”

APPENDIX III

PILOT STUDY REPORT

A pilot study was undertaken during May-June 2015 to test the ideas and measure the validity and reliability of questionnaire that was used to collect data to answer research questions. The questionnaire was drafted based on literature keeping the research objectives in mind. The sample size was 30, and the respondents were selected using convenience sampling method. Statistical testing was done to find out the reliability. The content validity of the questionnaire was scrutinized by subject experts. The respondents included decision makers of software product companies located in Bangalore. The respondents understood most of the questions easily. Some of the questions that were found to be double-barreled were re-framed. Some of the options that were not included in the questionnaire but opted by the respondents were later included in the final questionnaire. The questionnaire was well understood and had clear instructions. The questionnaire was re-drafted after making changes to wordings of the sentence, order of questions, the range of answers on multiple-choice questions and removal of some questions that was unnecessary or ambiguous. The reliability was checked by calculating Cronbach's alpha Cronbach's alpha for all items was 0. 765. The time taken to fill the questionnaire was found to be less than 20 minutes.

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Conference Presentation and Journal Publication

Conference Presentation and Publication

1. Sumukh S Hungund and Kiran K B, Trading Of Intellectual Property Rights: An Innovation Practice And Its Influence On Performance Of Small And Medium Firms In Software Product Segment, International Conference on Law and Economics 2016 at IIT Kanpur, September 2016

2. Sumukh S Hungund and Kiran K B, Open Innovation- A Need of the Hour for Indian Small and Medium Enterprises, 4th International Conference on Sustainability and Management Strategy, IMT NAGPUR, September 2015

3. Sumukh S Hungund and Kiran K B, Open Innovation practices and challenges among Indian SMEs, International Conference on Business Paradigms in Emerging Markets NIT Rourkela, December 2014

4. Sumukh S Hungund and Kiran K B, Impact of Policies on Sustainability of MSME sector in select states of India , 17th Nirma International Conference of Management January 2014

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1. Hungund, S. and Kiran, K. B., (2017). “Open Innovation Practices Among Indian Software Product Firms: A Pilot Study.” International Journal of Innovation and Sustainable Development, 11(4), 355-376 (Indexed in SCOPUS, Inderscience Publication) **DOI**: 10.1504/IJISD.2017.10003846

2. Hungund, S. S. and Kiran, K. B. (2016). “Open Innovation- A Need of the Hour for Indian Small and Medium Enterprises.” Dharana - International Journal of Business, 10(1),03-09, ISSN 0974-0082 (Indexed in CABIL’S DIRECTORY)

Curriculum Vitae

Sumukh S. Hungund

Mobile: +919980876542

E-Mail: sumukh.hungund@gmail.com

Profile Summary:

- 12+ years of combined experience in Teaching, Research, and Industry.
  - 5+ years of teaching experience
  - 3+ years of industry experience in Business Development, Recruitment, and Training.
  - 4 years of experience in Research

Education Background:

- Ph.D. Thesis submitted to School of Management, National Institute of Technology Karnataka (NITK), Surathkal.
- M.B.A with First Class from M.P. Birla Institute of Management, Bangalore in 2004.
- B.Tech (Textiles) with Distinction from Govt. S.K.S.J.T.I, Bangalore in 2001.

Professional Experience:

1. Institute Research Scholar at National Institute of Technology Karnataka, Surathkal from July 2013 to June 2017
2. Associate Professor with Department of Management Studies, B V B College of Engineering and Technology, Hubli from November 2011 to June 2013.
3. Senior Lecturer with Department of Management Studies, B V B College of Engineering and Technology, Hubli from February 2009 to October 2011.
4. Freelance Consultant with various start-up firms from October 2006 till January 2009.

5. Lecturer with Department of Management Studies and Research Centre B.M.S College of Engineering, Bangalore from October 2005 to September 2006.
6. Executive - Business Support with Nous Info System Pvt. Ltd. as from April 2005 to September 2005.

Roles & Responsibilities during Academic Tenure

- ❖ Subjects Taught: Research Methodology, Marketing, Entrepreneurship, Supply Chain Management and General Management.
- ❖ Departmental representative for ISO, BVBCET.
- ❖ Member - BoS, BoE, and DPGC for Management Studies, BVBCET (from 2009 to 2013).

Key Accomplishments

- ❖ Co-ordinated Faculty Development Program on "Research in Management" in July 2009.
- ❖ Co-ordinated BVB-SMSR Expert Lecture series in 2013.
- ❖ Guided 18 MBA students for Dissertations.

Awards & Recognition

- ❖ Received full fellowship from MHRD, GOI for pursuing Doctoral Studies.
- ❖ Received 2nd prize for the best technical paper during National Conference at Kousali Institute of Management Studies, Dharwad, October 2011.

Journal Publications:

1. Hungund, S. and Kiran, K. B. (2017). Open Innovation Practices Among Indian Software Product Firms: A Pilot Study, International Journal of Innovation and Sustainable Development 11(4) 355-376 (Inderscience Publication, Scopus Indexed). **DOI**: 10.1504/IJISD.2017.10003846
2. Hungund, S. and Kiran, K. B. (XXXX). Trading Of Intellectual Property Rights and Its Influence on Performance of Small and Medium Firms in Software

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Conference Presentations

1. Sumukh S Hungund and Kiran K B, Open Innovation Approach for Small and Medium Enterprises: An Evidence from Indian Software Product Firms, South Asian Conference on Business Models and Social Entrepreneurship at TISS, Mumbai , January 2017
2. Sumukh S Hungund and Kiran K B, Trading Of Intellectual Property Rights: An Innovation Practice And Its Influence On Performance Of Small And Medium Firms In Software Product Segment, International Conference on Law and Economics 2016 at IIT Kanpur, September 2016
3. Sumukh S Hungund and Kiran K B, Open Innovation- A Need of the Hour for Indian Small and Medium Enterprises, 4th International Conference on Sustainability and Management Strategy, IMT NAGPUR, September 2015
4. Sumukh S Hungund and Kiran K B, Open Innovation practices and challenges among Indian SMEs, International Conference on Business Paradigms in Emerging Markets NIT Rourkela, December 2014
5. Sumukh S Hungund and Kiran K B, Impact of Policies on Sustainability of MSME sector in select states of India , 17th Nirma International Conference of Management ,January 2014

6. Gujanal Prashant U and Sumukh S Hungund, Consumer Behavior towards Branded Men's Shirts, 7th SIMSR Asia Marketing Conference Mumbai, January 2012
7. Gujanal Prashant U and Sumukh S Hungund, A study on state support towards development of entrepreneurship in Karnataka, National Conference at Kousali Institute of Management Studies, Dharwad, October 2011
8. Sumukh S Hungund and Gujanal Prashant U, Relevance of Gandhian Principles for Business Organization", International conference on Gandhian Values: Sustainability & corporate Governance, Bangalore, October 2011
9. Sumukh S Hungund and Jamashetti Vanishree K, Divine Mantra for People Management: An emphasis building organization & leadership at workplace, National conference on Business Convergence, Nagpur, March 2011.

Key Workshop/Short-term Courses Attended

1. 9th National Level workshop on Research Methodology and Statistics using SPSS at ITM University, Gwalior during May 2016
2. Short-Term Course on 'Time Series and Panel Data analysis using EViews and STATA at National Institute of Technology, Tiruchirappalli during Jan 2016.
3. Panel Data Econometrics and its Application at GIPE, Pune from 7th to 9th Jan 2015
4. AICTE sponsored Quality Improvement Program on "Research Methodology" at National Institute of Technology, Calicut during June 2010.
5. AICTE sponsored Quality Improvement Program on "Management & Strategy" at NMIMS, Mumbai during January 2006.

Personal Details

Date of Birth: 26th August 1979

Marital Status: Married

Hobbies: Listening to Indian Classical Music

Language Known: English, Hindi, and Kannada.