ISTANBUL TECHNICAL UNIVERSITY ★ GRADUATE SCHOOL OF SCIENCE ENGINEERING AND TECHNOLOGY

OPEN INNOVATION PRACTICES IN SCIENCE PARK FIRMS IN TURKEY

M.Sc. THESIS

Kübra ŞİMŞEK

Department of Management Engineering

Management Engineering Programme

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İSTANBUL TEKNİK ÜNİVERSİTESİ ★ FEN BİLİMLERİ ENSTİTÜSÜ

TÜRKİYE'DEKİ TEKNOKENT FİRMALARINDA AÇIK İNOVASYON UYGULAMALARI

YÜKSEK LİSANS TEZİ

Kübra ŞİMŞEK
(507121019)

İşletme Mühendisliği Anabilim Dalı

İşletme Mühendisliği Programı

Tez Danışmanı: Doç. Dr. Nihan YILDIRIM

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Kübra Şimşek, a **M.Sc** student of ITU **Graduate School of Science Engineering and Technology** student ID **507121019**, successfully defended the **thesis** entitled "**OPEN INNOVATION PRACTICES IN SCIENCE PARK FIRMS IN TURKEY**", which she prepared after fulfilling the requirements specified in the associated legislations, before the jury whose signatures are below.

Thesis Advisor :	**Assoc. Prof. Nihan YILDIRIM** İstanbul Technical University	.....
Jury Members :	**Prof. Dr. Hacer ANSAL** Işık University	.....
	Assoc. Prof. Hür Bersam BOLAT İstanbul Technical University	.....

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To mom and dad,

FOREWORD

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May 2015 Kübra Şimşek

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ABBREVIATIONS

CIS	**:** Community Innovation Survey
EU	**:** European Union
IASP	**:** International Association of Science Parks
ICT	**:** Information and Communication Technology
IP	**:** Intellectual Property
R&D	**:** Research and Development
SME	**:** Small and Medium-sized Enterprises
TDK	**:** Turkish Language Association (Turkish: Türk Dil Kurumu)
TL	**:** Turkish Lira
TTO	**:** Technology Transfer Office
TUBISAD	**:** Turkey Informatics Industry Association (Turkish: Türkiye Bilişim Sanayicileri Derneği)
TUBITAK	**:** The Scientific and Technological Research Council of Turkey (Turkish: Türkiye Bilimsel ve Teknolojik Araştırma Kurumu)
UKSPA	**:** United Kingdom Science Park Association
UNDP	**:** United Nations Development Programme
UNFSTD	**:** United Nations Fund for Science and Technology for Development

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A RESEARCH ON OPEN INNOVATION PRACTICES IN SCIENCE PARK FIRMS IN TURKEY AND IMPROVEMENT SUGGESTIONS

SUMMARY

In today's world, international competition has been growing increasingly and to keep up with the times is the sole remedy to survive in this competitive environment that forces its actors to create innovations in every part of life. Therefore, in all developed or developing countries, companies are in a struggle for making innovations at all levels of production and sales as well as developing new products constantly. On the other hand, making innovation through using a firm's own internal resources makes it difficult to survive in the competitive environment no matter how efficient a company works. Even the largest companies with the most extensive in-house capabilities have difficulties in conducting technological innovation activities by themselves. As a matter of fact, even the competing firms use complementary R&D resources in cooperation jointly to reduce costs and risk when they conduct complex, time-consuming, and costly innovation activities. Furthermore, firms prefer to develop innovations with external suppliers, consumers, and customers instead of developing with only company employees. All these emerging developments indicate that a new paradigm that brings a new perspective to innovation and will shapes the future of it has arisen. This new paradigm is open innovation approach that serves as a bridge between internal and external knowledge.

Open innovation that is known as the use of purposive inflows and outflows of knowledge with a view to accelerating firms' own internal innovation, and expanding the markets through external use of innovation, respectively is a very important window of opportunity for the firms, which are obliged to improve their innovativeness continuously due to intense competition environment. On the other side, science parks give technology firms an opportunity to innovate, act as an intermediary between technology developer and technology deployer, and create value because of the fact that science parks transfer know-how and invention from universities and research institution laboratories to the market. By taking the collaboration and networking characteristics of science parks into consideration, it can be said that science parks are mediator and provider of open innovation for universities, research laboratories, start-ups, SMEs and large companies. However, some small companies in university-based science parks may be inclined to keep their innovation systems closed and prefer to stay in their own collaboration networks on the purpose of protecting their technological knowledge and know-how from greater and more competitive firms. Unfortunately, this orientation to closed approaches hinders those small companies from benefiting from university-based science park ecosystem and sharing knowledge with similar firms.

In this context, the main aim of this study is to get status of open innovation in technology-intensive companies, which operate in science parks in Turkey. Besides, determining motivation factors during the use of open innovation, determining the

problems and obstacles faced by technology-intensive companies that operate in science parks and revealing necessary strategies and improvement areas in order to benefit more from open innovation are also intended.

A survey has been conducted to 102 technology-intensive firms, which operate in science parks in Turkey in an attempt to investigate open innovation practices, motives, constraints, and actions to compensate barriers on competition. Therewithal, some general information such as types, scales, structures, shareholder type and experience of firms has been investigated in order to understand their impact on the orientation towards open innovation. Furthermore, innovativeness levels of technology-intensive companies that operate in science parks have been also investigated to research relationship between innovation and open innovation. The data obtained has been analyzed with statistical analysis methods by using SPSS software package.

Open innovation approach is not widespread among technology-intensive companies that are mostly small and medium-sized enterprises and operate in science parks in Turkey in spite of the fact that it is generally practiced by these companies. Inbound open innovation practices are used more by science park companies in comparison with outbound open innovation practices. The most used open innovation practices are customer immersion, collaboration, and lead users, respectively and the least preferred open innovation practice is idea competitions.

The most important motives to practice open innovation are exploring new technological trends, accelerating time to complete R&D, and identifying new business opportunities. On the other hand, establishing new partnerships is the least important motive to engage in open innovation for technology-intensive companies that operate in science parks. The most common constraints on open innovation that are encountered by science park companies are administrative constraints, constraints regarding resources and costs, and constraints regarding management and organization. On the other side, constraints regarding human resource, brand and image are the least frequently encountered constraints by science park firms.

Improving quality of products, improving marketing activities, and forming strategic partnerships are the most important actions to compensate barriers on competition for technology-intensive companies that operate in science parks. However, reducing production and increasing working hours are the least important actions to compensate barriers on competition.

TÜRKİYE'DEKİ TEKNOKENT FİRMALARINDA AÇIK İNOVASYON UYGULAMALARI ÜZERİNE BİR ARAŞTIRMA VE İYİLEŞTİRME ÖNERİLERİ

ÖZET

Günümüz dünyasında, uluslararası rekabet hızla artmaktadır ve aktörlerini hayatın her alanında inovasyonlar yaratmaya zorlayan bu rekabet ortamında hayatta kalabilmek için tek çare, zamana ayak uydurabilmektir. Bundan dolayı, tüm gelişmiş ve gelişmekte olan ülkelerde, firmalar sürekli olarak yeni ürünler geliştirmenin yanında üretim ve satışın her kademesinde yenilikler yapma çabası içindedir. Öte yandan, ne kadar etkin olduğundan bağımsız bir şekilde, bir firmanın sadece kendi iç kaynaklarını kullanarak inovasyonlar yapması, bu rekabet ortamında hayatta kalabilmesini güçleştirmektedir. En geniş firma içi yeteneklere sahip olan en büyük firmalar bile teknolojik inovasyon faaliyetlerini kendi başlarına sürdürürken zorluk çekmektedir. Doğruyu söylemek gerekirse, birbirleriyle rekabet halinde olan firmalar dahi karmaşık, zaman alan ve yüksek maliyetli inovasyon aktivitelerini sürdürürken maliyette ve riskte azalma sağlayabilmek adına işbirliğine giderek birbirini tamamlayan Ar-Ge kaynaklarını ortaklaşa kullanmaktadır. Dahası, firmalar inovasyonlarını sadece firma çalışanları ile geliştirmek yerine dışarıdan tedarikçiler, tüketiciler ve müşteriler ile geliştirmeyi tercih etmektedir. Ortaya çıkan tüm bu gelişmeler, inovasyona yeni bir perspektif kazandıran ve inovasyonun geleceğini şekillendirecek olan yeni bir paradigmanın doğduğunun göstergesidir. Bu yeni paradigma, iç ve dış bilgi arasında köprü görevi üstlenen açık inovasyon yaklaşımıdır.

Firmaların inovasyonlarına ivme kazandırmak ve harici firmaların inovasyon geliştirmelerine katkı sağlayarak pazarı genişletmek maksadı ile amaca yönelik bilginin firma dışından firma içine ya da firma içinden firma dışına kullanımı olarak bilinen açık inovasyon, yoğun rekabet ortamı dolayısıyla yenilikçiliğini sürekli geliştirmek mecburiyetinde olan firmalar için çok önemli bir fırsat penceresidir. Öte yandan, teknoparklar teknoloji firmalarına yenilik yapma olanağı sağlar, teknoloji geliştiriciler ile teknoloji yayıcılar arasında aracı rolü üstlenir ve üniversite ve araştırma kurumu laboratuvarlarından piyasaya teknik bilgi ve buluş transferi ile değer yaratır. Teknoparkların işbirlikçilik ve ağ oluşturma özellikleri de göz önüne alındığında, teknoparkların üniversiteler, araştırma laboratuvarları, genç yenilikçi şirketler, KOBİ'ler ve çok uluslu şirketler için açık inovasyonun aracısı ve sağlayıcısı oldukları söylenebilir. Fakat üniversite temelli teknoparklardaki bazı küçük şirketler, teknolojik ve teknik bilgilerini daha büyük ve daha rekabetçi firmalardan korumak amacıyla inovasyon sistemlerini kapalı tutma ve kendi işbirliği ağlarının içinde kalma eğiliminde olabilmektedirler. Ne yazık ki, kapalı yaklaşımlara olan bu yönelim, bu firmaların üniversite temelli teknopark ekosisteminden yararlanmasını ve benzer firmalar ile bilgi paylaşımını engellemektedir.

Bu çerçevede, bu tez çalışmasının temel amacı; açık inovasyon uygulamaları konusunda Türkiye'deki teknoparklarda kurulu teknoloji yoğun işletmelerin mevcut durumlarının ortaya konulmasıdır. Ayrıca, açık inovasyon kullanımı teşvik eden faktörlerin ve açık inovasyona ilişkin problemlerin belirlenmesi ve açık inovasyondan daha çok yararlanabilmek için gerekli strateji ve iyileştirme alanlarının ortaya konulması da amaçlanmaktadır.

Çalışmada öncelikle inovasyon ve inovasyon türlerine ilişkin literatür çalışması yapılmıştır. Daha sonra bir icadın nasıl değere dönüştürülebileceği tartışılmış ve bu hususla ilgili olan yeni paradigmalara dair literatür taraması yapılmıştır. Bu yeni paradigmalardan biri olan açık inovasyon yaklaşımının üzerinde durulmuş ve açık inovasyon yöntemleri ayrıntılı bir şekilde irdelenmiştir. Bunun dışında, KOBİ'ler, KOBİ'lerde açık inovasyon ve teknoloji geliştirme bölgeleri incelenmiştir.

Literatürden derlenen bilgiler ve konuyla ilgili bir uzmandan alınan öneriler ışığında hazırlanan bir anket çalışması, faaliyette bulunun 41 teknoloji geliştirme bölgesindeki 515 teknoloji yoğun işletmeye gönderilmiştir ve ankete 102 firmadan katılım sağlamıştır. Anket çalışmasının dışında, bir teknoloji yoğun KOBİ ile yüzyüze mülakat gerçekleştirilmiştir. Anket çalışmasında, açık inovasyona yönelimi etkileyen faktörlerin etkilerinin anlaşılması amacıyla firmaların tipi, ölçeği, yapısı, hissedar türü, deneyimi vb. genel bilgilere yer verilmiştir. Bunun dışında, inovasyon ve açık inovasyon arasındaki ilişkileri ortaya çıkarmak için, teknoloji geliştirme bölgelerinde bulunan firmaların yenilikçilik seviyeleri araştırılmıştır. Son olarak açık inovasyon faaliyetlerine ilişkin sorular sorulmuş ve firmaların açık inovasyon bilgi düzeyleri, açık inovasyon kullanımın önündeki engeller, açık inovasyon kullanımının motivasyon faktörleri, firmaların stratejileri, açık inovasyona yapılan yatırımın düzeyi gibi konular araştırılmıştır.

Elde edilen veriler SPSS yazılım paketi kullanılarak test edilmiştir. Öncelikle verilerin güvenirlik analizi yapılmıştır ve betimleyici istatistikleri verilmiştir. Çalışmada ayrıca faktör analizi yapılmıştır. Oluşturulan hipotezlerin bir kısmı, t-testi, ANOVA, Mann-Whitney u testi, Kruskal-Wallis testi gibi istatistiksel test metotları yardımıyla test edilmiş ve farklılıklar araştırılmıştır. Hipotezlerin kalan kısmı ise ilgileşim analizine tabi tutulmuş ve istatistiksel olarak anlamlı ilişkilerin olup olmadığı incelenmiştir.

Farklılık testleri ile firma yaşı, firmanın faaliyet gösterdiği teknoloji geliştirme bölgesinin bulunduğu coğrafi bölge, firmanın hedeflediği pazar, çalışan sayısı, yıllık ciro ve açık inovasyona geçiş süresi gibi faktörlerin, kullanılan açık inovasyon yöntemlerini, motivasyon faktörlerini, açık inovasyon üzerindeki engellerle karşılaşma sıklığını ve firmaların engellere yönelik stratejilerini farklılaştırıp farklılaştırmadığı incelenmiştir. Buna ek olarak, açık inovasyon pratiklerinin inovasyon geliştiriciler, inovasyon seviyesi ve açık inovasyon kategorisinde bulunan ürünlere yapılan yatırım miktarı gibi faktörler tarafından farklılaşıp farklılaşmadığı da araştırılmıştır.

Yapılan analizler neticesinde, açık inovasyon yaklaşımının teknoloji geliştirme bölgelerinde faaliyet gösteren işletmeler tarafından büyük oranda kullanıldığı görülmüştür. Gelen açık inovasyon yöntemleri, giden açık inovasyon yöntemlerine kıyasla teknopark firmaları tarafından daha çok kullanılmaktadır. En çok kullanılan açık inovasyon yöntemleri sırasıyla, müşteriyi dâhil etmek, işbirliği yapmak ve öncü kullanıcılardan yararlanmaktır. En az tercih edilen yöntem ise fikir yaratma yarışmaları düzenlemektir.

Teknoparklarda faaliyet gösteren teknoloji yoğun işletmeler için, açık inovasyon kullanımının en önemli isteklendirme faktörleri, yeni teknolojik eğilimleri keşfetmek, araştırma ve geliştirme faaliyetlerinin tamamlanma süresine ivme kazandırmak ve yeni iş fırsatları saptamaktır. Öte yandan, yeni ortaklıklar kurmak, bu firmalar için en az öneme sahip olan isteklendirme faktörüdür. Açık inovasyon kullanımının önündeki en büyük engellerin yönetimsel engeller, kaynaklar ve maliyetlerle ilgili engeller ve yönetim ve organizasyon ile engeller olduğu görülmüştür. Diğer taraftan, insan kaynakları, marka ve imaja yönelik engeller, teknopark firmaları tarafından en az karşılaşılan engellerdir.

Rekabet üzerindeki engelleri telafi etmek amacıyla gerçekleştirilen faaliyetler arasında teknoloji yoğun teknopark firmalarının en çok önem verdiği faaliyetler, ürün kalitesini artırmak, pazarlama aktivitilerini artırmak ve stratejik ortaklıklar kurmaktır. Üretimi azaltmak ve çalışma saatlerini artırmak ise teknoloji geliştirme bölgelerinde faaliyet sürdüren firmaların en az önemsedikleri faaliyetlerdir.

Teknokent firmaları açık inovasyonu daha çok yapısal olmayan bir yaklaşımla kullanmaktadır ve bu firmaların açık inovasyon konusunda tam anlamıyla bilgilerine güvenmedikleri görülmektedir. Bu yüzden, açık inovasyon uygulaması sırasında daha yapısal yaklaşımlara ihtiyaç olduğunu söylemek mümkündür. Dolayısıyla, özellikle teknoparklarda faaliyet gösteren küçük ve orta ölçekli firmalarda, açık inovasyon konusunda bilgilendirme ve söz konusu firmalara destek sağlama gereği ortaya çıkmaktadır.

1. INTRODUCTION

After the industrial revolution, science and technology began to progress rapidly and several inventions and discoveries were made. Also, these developments in science and technology have led to the commercial competition in progress of time. Hence, in such an environment, concept of innovation has gained importance in order to increase profitability, compete with others and even survive. In today's rapidly increasing competitive environment, it is a crystal-clear fact that making innovation and hence innovativeness are required to achieve differentiation and cost advantage. Unfortunately, generating innovation through using firms' own limited internal resources makes it difficult to compete in the market no matter how efficient companies work. Therefore, information and resource sharing and collaboration have been at innovators' agenda throughout entire value chain and competitive forces. The concept of open innovation was originated and popularized by Henry Chesbrough for the first time and this concept has enabled entrepreneurs, especially SMEs to improve their innovativeness.

Indeed, in comparison with their larger counterparts, SMEs need to exploit external resources, technologies and competencies more, which are limited or not available in the firm in order to innovate and commercialize their products and services successfully. Particularly, this approach is more relevant in high-tech SMEs. In addition, entrepreneurs whose focus is technology development such as technology start-ups or spin-off companies in science parks can be considered as potential users and practitioners of open innovation as those entrepreneurs are in constant need of patenting and licensing new technologies as a part of their business model. It is quite obvious that there is a necessity to shed some light on determining the levels of practicing open innovation in these types of companies with an eye to providing a strategic framework for science parks that can enable them to take

advantage of open innovation for realizing their mission and achieving their goals. Especially in developing countries, in recent years there are important attempts to establish science parks within university eco-system to construct the corporate infrastructure, which is essential to triple helix of academic entrepreneurship and catch up with the developed countries in terms of university-industry collaboration.

Unfortunately, the literature review has showed that there are very few academic studies in the literature regarding open innovation in SMEs and science park companies. Considering all these factors, based on the survey and in-depth interview with technology intensive companies from university-based science parks in different parts of Turkey, this thesis study aims to explore the ICT companies that are mostly conforming to the definition of SME and located in science parks in Turkey, in terms of their open innovation practices, intentions, motives and challenges.

This thesis study comprises of four sections. In the first part, literature rewiew regarding innovation, open innovation, SMEs, and science parks has been presented. Second part involves definitions and discussions of the research methods and techniques used in this thesis study. Also, aims and contributions of this study have been given in this section. In the third part, characteristics of the participant companies have been presented and hypotheses have been tested. Finally, summary of findings, conclusion and limitations of the thesis study and recommendations for future research have been given in the last part.

2. INNOVATION

Principally, innovation concept has been investigated regarding target area of research subject. It is quite obvious that there are lots of meanings of innovation in the literature. Innovation word comes from a Latin word, innovatus, connected with both change and renewal concepts.

Economist and political scientist Schumpeter have argued innovation as "driving force of economic development" for the first time. In his book, that was written in 1911 and translated into English in 1934, Schumpeter describes innovation as launching of a new product, adding new features to a known product, implementing of new production methods, launching a new market, acquiring new resources to supply raw materials or semi-finished goods, and creating a new industry structure (Schumpeter, 1934).

Innovation serves the purpose of marketing new products and includes all planning, production, management, and commercial activities that are conducted for the purpose of using a new process or equipment commercially (Freeman, 1982). According to Drucker (1985), "innovation is the specific function of entrepreneurship", and he considers innovation as a means which enables entrepreneurs to create new resources or enhance existing resources for creating wealth.

According to Oslo Manual (2005), "an innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations".

In a broad sense, innovation means "converting the knowledge into economic and social benefit", and this is why innovation is whole of technical, economic and social processes (Elçi, 2006). One of the broadest definitions was given by Nelson and

Winter (1977). They posit that "any nontrivial change in a product or process, if there has been no prior experience, is an innovation" (Nelson & Winter, 1977).

Turkish Language Association (TDK) in Science and Art Glossary has translated innovation word into Turkish qua "Yenilik". However, that Turkish word is more feasible to stand for novelty. One of the biggest traps a manager could fall in is not to differentiate between the definition of innovation and novelty. Drucker (1985) articulates that innovation creates value as distinct from novelty. Kırım (2006) mentions the difference between innovation and novelty, as well. A novelty should be differentiated as compared with other rival products or services in the market, in order to be seen as innovation (Kırım, 2006).

Furthermore, the meaning of the innovation word bears a resemblance to the meaning of the invention word, as well. Yet, the meanings of these two terms differ from each other. The innovation process comprises both technical component and the commercialization of that technology at the same time. Technical component can be termed as invention and the commercialization of the technology can be termed as innovation (Bogers & West, 2010). Webster (2014) defines the invention as "the act or process of inventing" and "a device contrivance, or process originated after study and experiment". Roberts (1988) describes invention as "coming up with an idea for a new product or process" and innovation is the aggregate of invention and exploitation in his article of which main points demonstrate the difference between invention and innovation (Roberts, 1988). Innovation involves two parts. First one is the creation of an idea or invention, and the second one is converting that invention into a business or other application that adds value to the user (Roberts, 2007). Freeman claims that innovation is carried out just with the first commercial transaction (Freeman, 1982). Besides, Chesbrough and Rosenbloom (2002), articulate that "The inherent value of a technology remains latent until it is commercialized in some way". Similarly, an invention can be considered as an innovation, if it is used socially (Hemlin and others, 2004). In that case, if the commercial transaction is not executed, everything that is obtained should be named as invention.

How we convert an invention into value should be understood. Recently, there are two overemphasized paradigms: traditional paradigm and a new paradigm that brings a new perspective to innovation. Traditional paradigm is based on conducting all

steps of innovation process within the firm. Then, the firm itself internalizes and controls both invention and commercialization entirely (Chandler, 1990). That is to say, a firm creates an invention, develops a product or service based on the invention within firm's own R&D departments, and controls its own distribution channels where its products commercialized. Traditional paradigm is also known as "Vertical Integration Approach" and Chesbrough (2003a) calls this approach as "Closed Innovation".

Many firms have achieved commercial successes through closed innovation in the twentieth century. However, closed innovation fell afoul of the knowledge landscape at the beginning of the twenty-first century and this paradigm has become obsolete owing to a number of erosive factors such as the increasing availability and mobility of skilled workers, the venture capital market, external options for ideas sitting on the shelf, the increasing capability of external suppliers (Chesbrough, 2003a). Chesbrough (2006) emphasizes the factors indicating a shift in management of innovation:

- Useful knowledge has become dispersed increasingly
- The business model procures the value of an idea or a technology
- Firms do not make use of full advantages of the wealth of information
- Ideas can be lost if they are not used willingly
- Firms need to sell and buy intellectual property
- Venture capital changes the innovation process for every person

Eventually, new paradigms based on a different knowledge landscape came up as opposed to traditional paradigm owing to these insights. These new paradigms that argue for multifarious sources of knowledge not managed by a single firm are "Cumulative Innovation", "Open Innovation", and "User Innovation". These all three distributed approaches attach particular importance to cooperation between actors (both individuals and corporates) in all stages of innovation contrary to traditional paradigm (Bogers & West, 2010).

User Innovation approach was originated by Eric von Hippel. He primarily introduced the lead user term in 1986 on the purpose of describing user innovation concept and explored the insights, which lead users can offer related to needs for innovative products, processes and services (von Hippel, 1986). User innovation

concept stands for making innovations by intermediate or consumer users such as user firms, individual end users and user communities, rather than by suppliers such as producers and manufacturers (Bogers and others, 2010). The main idea of this concept is users know what they need, and they can create innovations regarding their unmet needs if they are enabled by several design and policy options. One of the options is modularity of product design or user toolkits particularly. Other options include firm policies and government policies that solicit and facilitate innovation (Bogers & West, 2010).

The first study regarding *cumulative innovation* belongs to Green and Scotchmer (1995). In this study, they promoted a two phased innovation model in which second innovation builds upon the first one. Studies related to cumulative innovation assume that "unmonetized knowledge spillovers between rivals play a crucial role in advancing technological progress and thus in improving societal welfare" (Bogers & West, 2010). It is clear that most of the innovations are built on former innovations and thus they are directly connected to intellectual properties.

Open innovation approach will be explained in detail in section 3.

2.1 Types of Innovation

Schumpeter (1934) distinguishes innovation between five types: new products, new methods of production, new sources of supply, the exploitation of new markets, and new ways to organize business. It is clear that, not only is innovation associated with product or process, but also marketing and organization (Gunday and others, 2011).

Bessant and Tidd (2007) assume that innovation can be described with a lot of dimensions. However, they reduce innovation to four types as product innovation, process innovation, position innovation and paradigm innovation. These are defined (Bessant & Tidd, 2007):

> Product innovation, changes in the things (products/services) which an organization offers;
>
> Process innovation, changes in the ways in which thing (products/services) are created and delivered;
>
> Position innovation, changes in the context in which the products/services are introduced;
>
> Paradigm innovation, changes in the underlying mental models which frame what the organization does.

In this thesis study, Oslo Manual (2005) has been taken as basic reference source because of the fact that it is the primary international basis of guidelines to define innovation and innovation activities. In addition, Oslo Manual (2005) became the reference for European Community Innovation Survey (CIS, 2010).

According to Oslo Manual (2005), there are four types of innovation: product innovation, process innovation, marketing innovation and organizational innovation. Product innovation and process innovation are directly associated with the concept of technological product and process innovation.

2.1.1 Product innovation

White and others (1988) define product innovation as "development of new products, changes in design of established products, or use of new materials or components in manufacture of established products". They claim that anything that is new to the firm and product range including making incremental changes on the product is considered as product innovation, even if there are similar products in the market (White and others, 1988).

According to Oslo Manual (2005), a product innovation is "the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses. This includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics". The product can be based on not only new knowledge and technology but also new use or combination of existing knowledge and technology. A product includes both good and service and product innovation includes both totally new good or service and significant improvements of existing good and service. For instance, the first digital camera was a new product using new technology and the first MP3 player was a new product combining existing technologies. Moreover, change in design, which does not include a significant improvement regarding functional characteristics or intended uses of a product, is not a product innovation. However, making minor changes in technical characteristics or specifications of a product to gain a new using is considered as product innovation (Oslo Manual, 2005).

According to Avermaete and others (2003), if any good, service or idea may be considered as new, it is product innovation. As it is understood, any good, service or idea may be considered as product innovation to one but not to others.

Although product innovations may arise from changes in organizational structure and exploitation of new market segments, they are mainly related to change in the process (Avermaete and others, 2003).

Product innovation helps companies out with retaining and growing competitive position irrefutably. It is safe to say that making incremental changes on the products and developing totally new products are fundamental in an attempt to retain market presence and not to stay behind of competitors (Johne, 1999).

2.1.2 Process innovation

Oslo Manual (2005) defines process innovation as "the implementation of a new or significantly improved production or delivery method" and process innovation also includes significant changes in techniques, equipment and software. Production methods comprise the techniques, equipment and software that are used for production. Delivery methods are related to logistics and involve techniques, equipment and software that are used for supplying, distribution of supplies within the firm, or delivering end product. The purpose of making process innovation can be decreasing unit costs of production or delivery, producing or delivering new or significantly improved products, or increasing quality. In addition, process innovation covers not only production and delivering methods but also related support activities like purchasing, accounting, computing and maintenance. For instance, if the firm sets its sight on improving the efficiency and quality of support activity, the implementation of a new or significantly improved information technology is considered as process improvement (Oslo Manual, 2005).

Although process innovations may be necessary for reshaping the organization or exploitation of new markets, they are mainly pave the way for the creation of new products (Avermaete and others, 2003).

A firm can produce the same product at a low cost and offer its products at a low price to customer so as to gain more customers if the process of process innovation is conducted efficiently (Johne, 1999).

2.1.3 Marketing innovation

Avermaete and others (2003) define marketing innovation as “exploitation of new territorial markets and penetration of new market segments within existing markets”.

Oslo Manual (2005) defines marketing innovation as “the implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing”. This type of innovation is made for understanding customer needs, exploring new markets, or positioning on a current market with a new product on the purpose of increasing sales. The distinctive point of a marketing innovation is applying of marketing method first time in the firm, in contrast with other marketing activities. Also, marketing innovation can be applied to both new and existing products (Oslo Manual, 2005).

When a marketing method was implemented before for an existed product of the firm and this marketing method will be implemented again for another product of the firm, it is not considered as a marketing innovation (Johne, 1999).

New marketing methods in *product design* change involves changes in product form and appearance, which do not have any effect on functional or user characteristics of the product. If package is the main deterministic element of the product, change in *packaging* is also accepted as marketing innovation. *Product placement* change comprises introduction of new sales channels that are primarily related to efficiency such as selling or serving methods. As it is understood, logistics methods like transport, storing etc. are not involved in product placement changes due to they are not mainly related to efficiency. For example, introduction of a franchising system or direct selling are product placement changes. Besides, using of new concepts to present products are marketing innovations as well. *Product promotion* changes comprise the use of new concepts with the intent of promoting goods and services of the firm. Product placement in a movie or using celebrity endorsements can be considered as product promotion if they are used first time. Innovation in *pricing* refers to using of new pricing strategies to commercialize products of the firm. If the sole purpose is differentiating prices by customer segments, it is not marketing innovation. Furthermore, routine changes (e.g. seasonal or regular) in marketing activity are not considered as marketing innovations if they do not involve new marketing methods to firm (Oslo Manual, 2005).

2.1.4 Organizational innovation

According to Oslo Manual (2005), an organizational innovation is "the implementation of a new organizational method in the firm's business practices, workplace organization or external relations". The distinctive point of an organizational innovation is implementing an organization method in business practices, workplace organization or external relations first time in the firm, in contrast with other organizational changes. Organizational innovations are implemented with the intention of increasing performance of the firm through reducing administrative or transaction cost, increasing employee satisfaction, reducing supply costs etc. (Oslo Manual, 2005).

The implementation of a new market method in the firm's *business practices* comprises organizing routines and procedures to manage works. Stated in other words, using and implementation of new practices to the end that improvement of knowledge sharing and learning within the firm can be considered as organizational innovation in the business practices of the firm. Establishing databases to make knowledge accessible to others, implementation of education and training systems, implementation of supply chain management systems or quality management systems first time within the firm can be given as example to organization innovation in business practices. Secondly, organizational innovation in *workplace organization* comprises implementation of new methods to distribute responsibilities among employees and implement new concepts to structure activities within the organization. On the other hand, centralization of activities for the first time can also be considered as innovation in workplace organization such as integrating sales and production as build-to-order production system. Moreover, organizational innovation in *external relations* of the firm contains implementation of new ways in relations with other firms or public institutions. However, merger with other firms or the acquisition of other firms are not organizational innovations, even if the firm does it for the first time (Oslo Manual, 2005).

According to Avermaete and others (2003), organizational innovation is connected to changes in sales, marketing, purchasing, administration, management and policy.

The relationships between product, process, marketing and organizational innovation are shown in Figure 2.1.

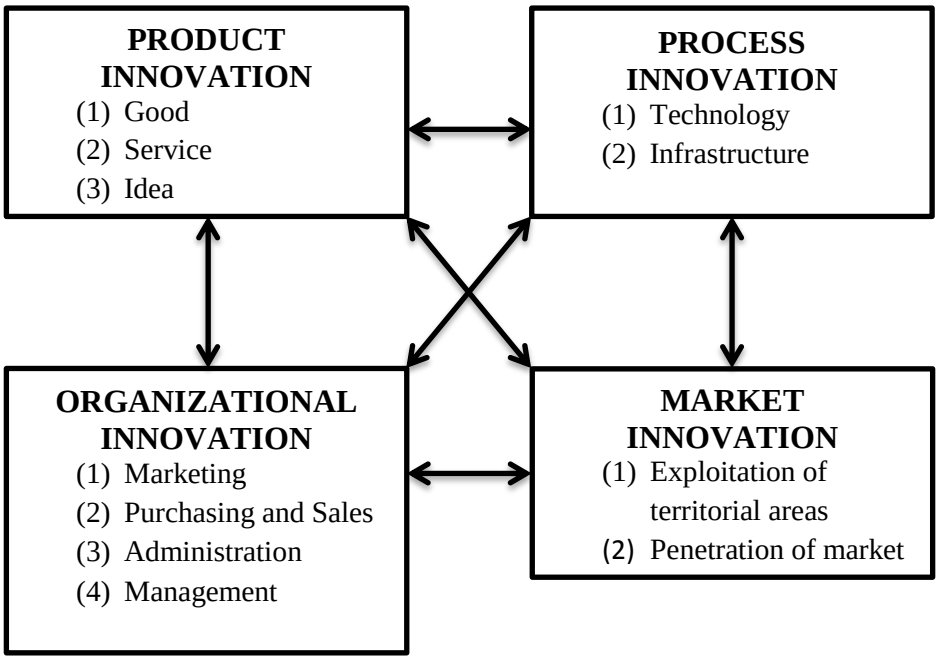

Figure 2.1 : Domains of Innovation (Avermaete and others, 2003).

3. OPEN INNOVATION

Substantially, the advantages of having external linkages for product development have been realized a long time ago. Trott and Hartmann (2009) argue that open innovation is “old wine in new bottles”. Carter and Williams (1959) discovered that the key characteristic of the firms, which made inroads in technology, was quality information from outside the firm. Also, Allen and Cohen (1969) proved the prominence of external linkages in information acquisition from outside the firm due to working through gatekeepers. However, Henry Chesbrough originated and popularized the term of open innovation for the first time.

While Chesbrough was working as a manager in Silicon Valley, he realized that there were not useful ideas from academia. The curiosities of both managers and academicians were totally different from each other. Then, he decided to enter a PhD program to do what he could to reduce this gap. As it is understood, open innovation concept was originated for that purpose (FORBES, 2011).

Although firms, which use closed innovation particularly bases on internal R&D, consider R&D labs as a strategic asset and create entry barriers for their potential rivals, open innovation paradigm assumes that any firm can no longer afford to make innovation by performing R&D and marketing activities single-handedly. Open innovation can be considered as the antithesis of the closed innovation that R&D activities and product development are conducted internally and also the products are distributed by the firm. This approach handles R&D as an open system (Chesbrough, 2006). By virtue of open innovation, precious ideas can come from inside or outside the firm and can go to market from both sides as well (Chesbrough, 2003a). Figure 3.1 illustrates the differences between closed innovation and open innovation.

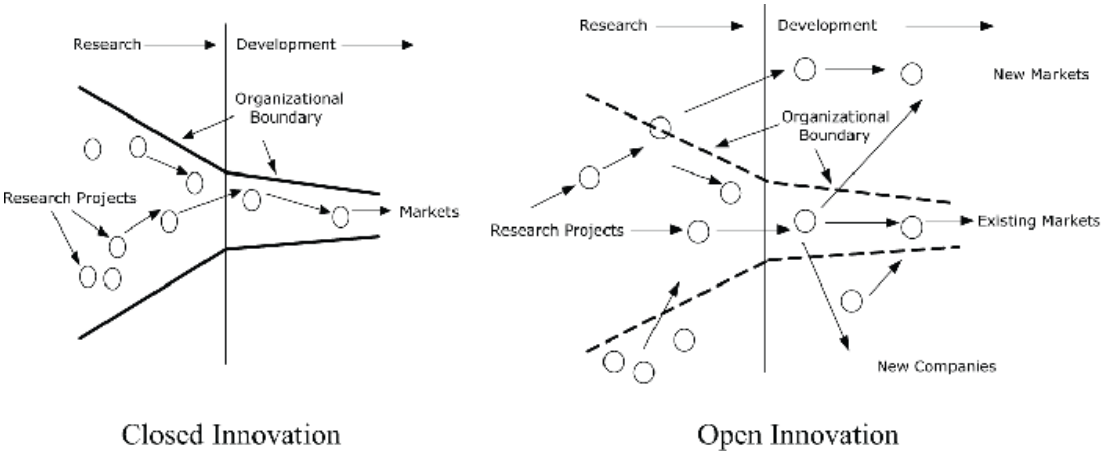

Figure 3.1 : Closed vs. Open Innovation (Chesbrough, 2003a).

In open innovation model, the boundary between a firm and its environment is more permeable. As a basis, open innovation is based on the principal of abundant knowledge that must be used quite easily when it is for providing value for the firm, which created it. So, this approach suggests some different rules in comparison with closed innovation approach. Chesbrough (2003b) demonstrates six so-called differences between closed innovation and open innovation as shown in the Table 3.1.

Table 3.1 : Contrasting principles of closed and open innovation (Chesbrough, 2003b).

Closed Innovation Principles	Open Innovation Principles
The smart people in our field work for us.	Not all of the smart people work for us so we must find and tap into the knowledge and expertise of bright individuals outside our company.
To profit from R&D, we must discover, develop and ship it ourselves.	External R&D can create significant value; internal R&D is needed to claim some portion of that value.
If we discover it ourselves, we will get it to market first.	We do not have to originate the research in order to profit from it.
If we are the first to commercialize an innovation, we will win.	Building a better business model is better than getting to market first.
If we create the most and best ideas in the industry, we will win	If we make the best use of internal and external ideas, we will win.
We should control our intellectual property so that our competitors do not profit from our ideas.	We should profit from others' use of our intellectual property whenever it advances our own business model.

Open innovation is defined as “the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively” (Chesbrough, 2006). In this respect, open innovation comprises two facets both as outside-in and as inside-out, stated in other words technology exploration and technology exploitation. While inbound open innovation, or technology exploration stands for innovation activities to capture and benefit from external sources of knowledge to leverage current technological developments, outbound open innovation, or technology exploitation suggests that firms can look for external organizations, whose business models are suitable for commercialization of a given technology. In a completely open system, firms would combine and capitalize both technology exploitation and technology exploration to get maximum value due to their technological capabilities and complementary competencies of others (Chesbrough & Crowther, 2006; Lichtenthaler, 2008; van de Vrande and others, 2009).

The most frequently used technology exploitation and technology exploration practices are shown in Figure 3.2.

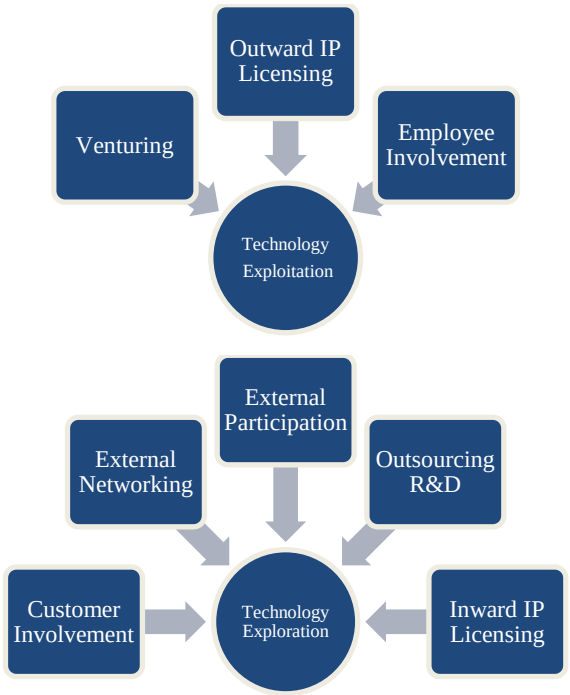

Figure 3.2 : The most frequently used technology exploitation and technology exploration practices (van de Vrande and others, 2009).

3.1 Facets of Open Innovation

3.1.1 Technology exploitation (outbound open innovation)

Firms can transfer their technologies to outside the firm through technology exploitation on the purpose of gaining benefit from internal knowledge. Technology exploitation is separated into three practices as venturing, outward licensing of intellectual property, and the involvement of non-R&D workers in innovation initiatives (van de Vrande and others, 2009).

Venturing is defined as starting up a new organization by practicing of spinning-off or spinning-out internally generated ideas. Apart from internal knowledge, support from the parent company may also include finance, human resources, legal advice, administrative affairs, etc. (van de Vrande and others, 2009). Chesbrough demonstrated the grand potential of venturing by indicating how the market value of 10 spin-off companies collectively goes beyond the value of the parent company, Xerox, by a factor of two at the end of 2001, although they fell sharply in 2000 and 2001 because of the collapse in technology stock prices (Chesbrough, 2003a).

IP has a place in open innovation in consequence of using inflows and outflows of knowledge, and means "subset of ideas that (a) are novel, (b) are useful, (c) have been reduces to practice in a tangible form, and (d) have been managed according to the law". IP includes patents, trademarks, copyrights, and trade secrets (Chesbrough, 2003a). *Outward-IP licensing* stands for commercialization of internal ideas to external companies whose business models fit the innovation better for putting on market (Chesbrough, 2006). In other words, outward IP licensing means offering or selling licenses to external organizations to generate better profit from firm's own intellectual property (van de Vrande and others, 2009). A company manages its intellectual property both developing its business and profiting from other companies' use of the company's knowledge (Chesbrough, 2003a). According to Gassmann (2006), having an intellectual property is more important than having a factory and IP have turned to a strategic asset. Companies can have more opportunities through licensing of their internally generated patents and trademarks to outside of the company (Gassmann, 2006). Lichtenthaler and Ernst (2007a) have showed the importance of being a valuable knowledge provider in the market on the

purpose of increasing benefits of technology out-licensing. Thus, companies can overcome the imperfections in the knowledge market.

Lastly, *employee involvement* means capitalizing on the knowledge of company's own employees even if they are not the employees of internal R&D departments (van de Vrande and others, 2009). Every employee in the organization, with different professions, background information, competencies, and experiences may provide value unexpectedly to innovation process of the company. Employees can be incorporated in innovation process of the company in several ways, such as by getting their opinions and suggestions, encouraging them to take initiatives or implement ideas, creating self-directed teams, organizing an internal competition, etc.(Van Dijk & Van den Ende, 2002).

3.1.2 Technology exploration (inbound open innovation)

Technology exploration stands for activities that enable the firm to acquire new knowledge and technology from outside the firm. The most commonly used technology exploration practices are separated into five groups as customer involvement, external networking, external participation, outsourcing R&D and inward licensing of IP (van de Vrande and others, 2009).

Customer involvement is one of the ways of technology exploration through counting customers in innovation process directly. To illustrate, the firm can conduct an active market research to understand needs of customers, or develop products on the basis of customers' modifications or specifications regarding similar products of the firm (van de Vrande and others, 2009). According to Gassmann, customer involvement is the major constituent of open innovation (Gassmann, 2006). Besides, von Hippel (1988) argues that customers are one of the external sources of useful knowledge and they are essential to marketing research thanks to having real life experiences with products. It was also specified that enabling users to make modification on machines, equipment and software helps company with better interface to the innovation process. (von Hippel, 2005).

External networking is yet another important component of open innovation (Chesbrough, 2006). It refers to draw on or corporate with external network partners in order to support innovation process and comprises all activities to acquire and preserve connections with these external sources of social capital, inclusive of

individuals and organizations. In other words, external networking includes formal collaborative projects, as well as informal networking activities. Owing to networks, knowledge gaps can be filled swiftly without the need for spending a lot of time and money (van de Vrande and others, 2009). R&D alliances can also be considered as networks and they have become famous between non-competing companies for acquisition of technology (Gomes-Casseres, 1997). In addition, Nooteboom argues that in his work, in which was examined the use of alliances in technology based industries, when firms focus on their core competencies and do not wish to develop adequate absorptive capacity themselves; they may utilize strategic alliances with the intent of gaining knowledge and obtaining the complementary competencies from other firms (Nooteboom, 1999). Other scholars have studied the use of alliances and *keiretsu*, or enterprise groups, particularly that comprise multifarious families of firms located around commercial companies, main banks, vertically integrated suppliers and distributers associated with outstanding manufacturers in several industries, such as electronics, automotive, etc. (Gerlach, 1992; Dyer, 1996).

External participation provides the company with improvement of innovations, which were originally deserted or looking unpromising. Enterprises may make equity investments in start-ups or existing businesses on the purpose of getting access to their knowledge or watching for potential opportunities (Chesbrough, 2006). When the watched technologies come to enterprises' attention, mentioned equity investments bring more opportunities for further external collaborations (van de Vrande and others, 2006).

Outsourcing R&D is another way of technology exploration and refers to buying R&D services from other organizations: public research organizations, universities, suppliers and so forth (van de Vrande and others, 2009). The assumption underlies open innovation concept is that handling all R&D activities on your own internally is not possible and external R&D creates significant value for enterprises. Gassmann (2006) enunciated that technical service providers such as engineering firms and high-tech institutions have become more valuable in the innovation process and many companies have reduced cost of R&D by means of R&D outsourcing.

The open innovation concept considers that the company should be an active buyer and seller of intellectual property. *Inward licensing of IP* stands for buying or only using intellectual property of external organizations, such as copyright, patent, or

trademark to gain benefit from innovation opportunities (Chesbrough, 2006). Firms put emphasis on selling their own IP to other firms than buying from outsiders but this is a dangerous oversight. They should consider the value that can be created by accessing external technologies, instead of recreating it unnecessarily (Chesbrough, 2003a). Inward licensing of IP may be vital for accelerating R&D and feeding business model of the company.

In the survey report for large firms, Chesbrough and Brunswicker (2013) differentiate between outbound open innovation where knowledge flows outside the firm, and inbound open innovation where external knowledge flows inside the firm. Also, they differentiate between non-pecuniary and pecuniary mode of open innovation. When the knowledge flows are non-pecuniary, there is not direct financial compensation and reward regarding it. For instance, in a non-pecuniary mode of inbound open innovation, a firm source external knowledge without financial reward and compensation. In contrast to non-pecuniary mode, in a pecuniary mode of inbound open innovation, a firm reveals knowledge freely via donations, etc. After making this differentiation, they classified the modes of open innovation as shown in the Figure 3.3.

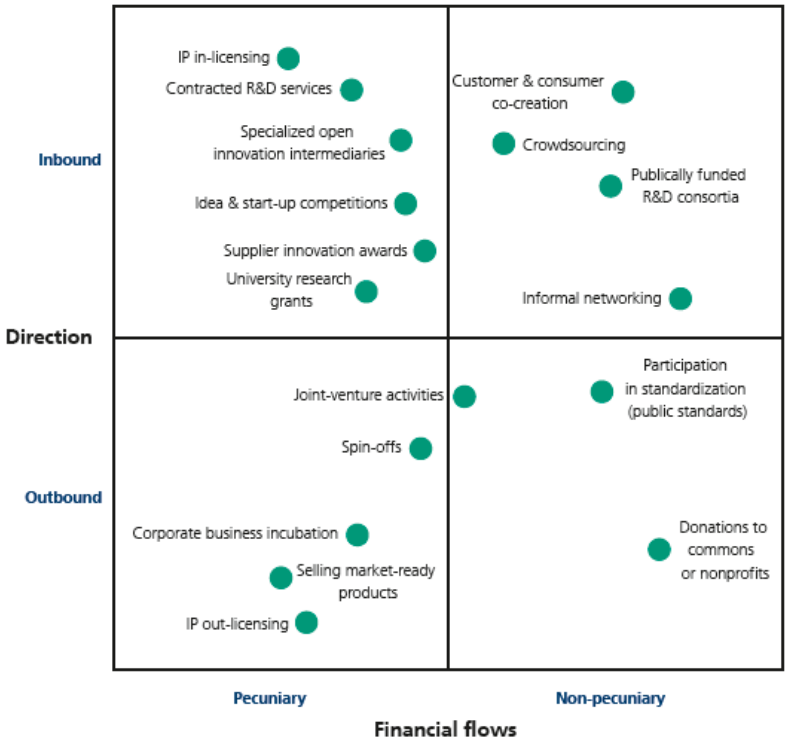

Figure 3.3 : Classification of modes of open innovation (Chesbrough and Brunswicker, 2013).

In their research on small and medium enterprises, Krause and others (2012) reviewed the literature, and they saw that there were various types of open innovation exist in the literature. Then, they extracted the main modes of open innovation after review of the literature. According to Krause and others (2012), the main modes of open innovation can be classified as platforming, idea competitions and challenges, customer immersion, collaboration, innovation networks, innovation intermediaries, IP or technology in-licensing or acquisition, IP or technology out-licensing or selling, and lead users. These all modes of open innovation are given with their descriptions in the Table 3.2.

Table 3.2 : Classification of modes of open innovation (Krause and others, 2012).

Open Innovation Type	**Description**
Platforming	Providing a base product to which customers can extend the capabilities of the product and add value to all involved (such as iPad and Apple store applications).
Idea Competitions / Challenges	Rewarding individuals, groups or companies for providing ideas to solve specific stated problems in the form of a competition or challenge.
Customer Immersion	Observation of the customer-product interaction process to further enhance products or services.
Collaboration	Developing new products, services or other capabilities through collaborating with customers, suppliers, or other 3rd parties.
Innovation Networks	Incorporating the input from a network of contributors such as innovation hubs, advisory boards and science centers.
Innovation Intermediaries	A company, which focuses its business on helping other companies, implements various facets of open innovation.
IP or Tech In-Licensing or Acquisition	Licensing or buying patents and technology and incorporating it into your organization.
IP or Tech Out-Licensing or Selling	Licensing or selling your own patents and technology to other organizations or spinning out a new company.
Lead Users	Identifying innovations added to your product by users for their own use and then incorporating the ideas back into your product.

3.2 Classifications of the Existing Studies on Open Innovation

In an attempt to make a thematic categorization of existing studies on open innovation, the themes that were determined by Elmquist and others (2009) and developed by Giannapoulou and others (2010) were used. Elmquist and others (2009) analyzed the related literature from 2003 to November 2007 and generated seven themes (see Table 3.3).

Table 3.3 : Previous themes (Elmquist and others, 2009).

Previous Themes
The notion of open innovation
Business models
Organizational design and boundaries of the firm (2)
Leadership and culture (4)
Tools and technologies
IP, patenting and appropriation (6)
Industrial dynamics and manufacturing (8)

Then, Giannapoulou and others (2010) predicated their research on mentioned research and developed it by taking newer studies (see Table 3.4) from November 2007 up until July 2009 into consideration.

Table 3.4 : Newer themes (Giannapoulou and others, 2010).

Newer Themes
Open innovation: the development of the concept (1)
Open strategy (3)
The human factor in open innovation (4)
Communities for distributed co-creation with customers and other collaborating actors (5)
Innovation intermediaries: A new business model arising (7)
Collaborating with academia (8)
Government policy (8)

In this way, they developed “leadership and culture” into “human factor in open innovation and “industrial dynamics and manufacturing” into “collaborating with academia and government policy”. Development of the new categories and description of them with the keywords are shown in the Table 3.5.

Table 3.5 : New classification and description of themes with the keywords (Giannapoulou and others, 2010).

New classification	Keywords
Open innovation the development of the concept	The concept of OI, the notion of OI, dimensions of OI, inside-out process, outside-in process, exploration, exploitation, model, framework
Organizational design and boundaries of the firm	Organization, organizational setup, organizational units, R&D organization, mechanisms, structures, process, inside-out process, outside-in process, inward process, outward process, product development process, stage gate model, stages, capabilities, competencies, resources, absorptive capacity, relative capacity, TCI capabilities
Open strategy	Strategy, strategic choice, strategic approach, technology exploration, technology exploitation, out-licensing, R&D alliances/collaborations, partnerships, academia, communities
The human factor in open innovation, culture and leadership	Leader, leadership, culture, mentality, mindset, cultural change, human factor, employees, customers, communities, motivation, motives, incentives, teamwork, team
Communities for distributed co-creation with customers and other collaborating actors	(Online) community, brand community, participations, OSS, open source, open standards, customer, customer involvement, customer participation, virtual worlds, avatars, co-creation
IP, patenting and appropriation	IP, intellectual property, IPR, intellectual property rights, technology assets, knowledge, sharing, free revealing, selective revealing, appropriability, regimes, patent, patent system, IP auctions, IP protection, secrecy.
Innovation intermediaries: A new business model arising	Technology or innovation intermediaries, knowledge brokers, solution providers, solver brokers, solution brokers, solution seekers, brokerage, technology transactions.
The triple helix: Academia, industry, government, policy	Industry, regional innovation systems, clusters, academia, universities, industry academia linkages, government, policy, policy makers, innovation systems, innovation regimes, global innovation networks

Different authors who have been active in the stated themes regarding open innovation are listed in the Table 3.6.

Table 3.6 : Studies regarding open innovation themes.

Themes	References
Open innovation the development of the concept	Chesbrough 2003a, 2003b, 2006, Gruber and Henkel 2006, Henkel 2006, Laursen and Salter 2006
Organizational design and boundaries of the firm	Cohen and Levinthal 1990, Chesbrough 2003a, Lichtenthaler and Ernst 2006, Spithoven and others 2010
Open strategy	Gomes-Casseres 1997, Noteeboom 1999, Simonin 1999, Narula 2004, Lichtenthaler 2008, van de Vrande and others 2009
The human factor in open innovation, culture and leadership	Katz and Allen 1982, Lichtentaler and Ernst 2006, Savitskaya and others 2010, Rahman and Ramos 2013
Communities for distributed co-creation with customers and other collaborating actors	Gassmann 2006, Desouza and others 2008, Piller 2010, Piller and others 2010
IP, patenting and appropriation	Chesbrough 2003b, 2003c, 2006, Gassmann 2006, Henkel 2006, Lichtenthaler and Ernst 2007a, van de Vrande and others 2009, Savitskaya and others 2010, Bogers and others 2012
Innovation intermediaries: A new business model arising	Howells 2006, Lichtenthaler and Ernst 2008, Sieg and others 2010, Agogué and others 2013
The triple helix: Academia, industry, government, policy	Perkmann and Walsh 2007, Narasimhalu 2013

Here is a point that different authors conceptualize openness differently. We have already discussed two facets of open innovation that are technology exploration and technology exploitation, stated in other words inbound and outbound innovation. Here, these different types of openness are again categorized as inbound and outbound referred to literature. In the sequel, inbound and outbound innovations are divided into two parts that are pecuniary and non-pecuniary. Pecuniary and inbound innovation is conceptualized as acquiring, pecuniary and outbound innovation is conceptualized as selling, non-pecuniary and inbound innovation is conceptualized as sourcing, and non-pecuniary and outbound innovation is conceptualized as revealing considering the studies in the literature regarding open innovation as shown in the Table 3.7.

Table 3.7 : Different types of openness in the literature regarding open innovation.

	Pecuniary	**Non-pecuniary**
Inbound OI (Technology Exploration)	Acquiring	Sourcing
Outbound OI (Technology Exploitation)	Selling	Revealing

Revealing stands for the way of revealing internal resources to external environment. That is to say, revealing is related to how companies reveal their internal resources without immediate financial expectations, seeking mediate gain to the company.

Selling deals with the way of commercialization of inventions and/or technologies through licensing out or selling resources that were developed in different organizations (Dahlander and Gann, 2010).

Sourcing stands for the way of using external innovation sources (Dahlander and Gann, 2010). According to Chesbrough (2006), when companies decide to start an internal R&D work, they scrutinize external environment. Then companies may use these external technology and ideas if they are available.

Acquiring can be defined as the use of input that was acquired through market place in the innovation process. That is to say, acquiring is related to how a company licenses in and acquires expertise from external environment (Dahlander and Gann, 2010).

Chesbrough and Rosenbloom (2002) argue that using different types of openness together in business model of the firm is crucial. After literature review, it was realized that a great majority of the studies focus on analyzing one or two types of openness. Only the studies of van de Vrande and others (2009) and Dahlander and Gann (2010) are praiseworthy exceptions because of the fact that they researched all different types of openness systematically. The studies, which focus on different types of openness, are listed in the Table 3.8.

Moreover, the studies on open innovation regarding firm size are researched.

Table 3.8 : Studies regarding different types of openness.

Type of Openness	Reference
Acquiring	Chesbrough and Crowther 2006, van de Vrande and others 2009, Dahlander and Gann 2010
Sourcing	Chesbrough 2006, Laursen and Salter 2006, van de Vrande and others 2006, 2009, Dahlander and Gann 2010, Brunswicker and Vanhaverbeke 2014
Selling	Chesbrough 2003a,2003b,2006, Chesbrough and Rosenbloom 2002, Lichtenthaler and Ernst 2007b, van de Vrande and others 2009, Dahlander and Gann 2010
Revealing	Henkel 2006, van de Vrande and others 2009, Dahlander and Gann 2010

Specifically, the studies on open innovation regarding firm size are also given in Table 3.9.

Table 3.9 : Studies regarding firm size.

Firm Type	Reference
Small and medium enterprises	Gomes-Casseres 1997, Kaufmann and Tödtling 2002, Narula 2004, Scozzi and others 2005, Gruber and Henkel 2006, van de Vrande and others 2009, Chesbrough 2010, Spithoven and others 2011, 2013, Hamdani and Wirawan 2012, Parida and others 2012, Brunswicker and Ehrenmann 2013, Hutter and others 2013, Rahman and Ramos 2013, Brunswicker and Vanhaverbeke 2014
Large enterprises	Granstrand and others 1992, Chesbrough and Rosenbloom 2002, Chesbrough 2003a, 2006, Kirschbaum 2005, Lichtentaler and Ernst 2007b, Gassmann and others 2010, Spithoven and others 2013

4. SMALL AND MEDIUM ENTERPRISES

In this thesis study SMEs are mostly focused on due to the fact that there is not enough study concerning SMEs in the open innovation literature. Definition, importance for economy and innovation, and structural advantages of SMEs are presented in this section, respectively.

4.1 Definition of SMEs

It is not easy to define SMEs, because of the fact that definition of SMEs vary by country. In Europe, the main factors to understand whether or not the enterprise is an SME are the number of employees and either annual turnover or balance sheet total. The exact definition of the European Commission is that:

> The category of micro, small and medium-sized enterprises (SMEs) is made up of enterprises, which employ fewer than 250 persons and which have an annual turnover not exceeding EUR 50 million, and/or an annual balance sheet total not exceeding EUR 43 million. (EU Recommendation 361, 2003)

According to this definition, SMEs are classified in Europe as shown in the Table 4.1.

Table 4.1 : Definition of SMEs in Europe (EU Resommendation 361, 2003).

Scale	Number of Employees	Annual Turnover (€)	Balance Sheet Total (€)
Micro	< 10	≤ 2 million	≤ 2 million
Small	< 50	≤ 10 million	≤ 10 million
Medium	< 250	≤ 50 million	≤ 43 million

In Turkey, the scale of enterprises is defined in terms of the same certain measure: the number of employees and either annual turnover or balance sheet total. Based on

Turkish Presidential Decree no. 2012/3834, enterprises whose number of employees are less than 250 and annual turnover does not exceed 40 million Turkish Liras are considered as SMEs (Official Gazette 3834, 2012). According to this definition, SMEs are classified in Turkey as shown in the Table 4.2 (Kobi.org.tr, 2014).

Table 4.2 : Definition of SMEs in Turkey (Kobi.org.tr, 2014).

Scale	Number of Employees	Annual Turnover (TL)	Balance Sheet Total (TL)
Micro	< 10	≤ 1 Million	≤ 1 Million
Small	< 50	≤ 8 Million	≤ 8 Million
Medium	< 250	≤ 40 Million	≤ 40 Million

4.2 Importance of SME's for Innovation and Economy

Importance of SMEs for innovation and economy is one of the major topics in the innovation literature. SMEs have a crucial role in the economic development of both developed and developing countries (Kaufmann & Tödtling, 2002; Kapurubandara & Lawson, 2006). They have an extraordinary ability to survive and increase their performance even in economic crisis. Hence, the development of SMEs makes contribution to economic and social development through their economic diversification and rapid structural changes (Hamdani & Wirawan, 2012). Also, it is globally noticed that SMEs not only have a crucial role in the economy, but also are essential to economic stability of a country (Ashrafi & Murtaza, 2008).

According to Acs (1992), small firms keep one step ahead of their larger counterparts in innovation, then the role of small business in economy deserves to be paid attention. SMEs are clearly different from larger companies regarding to how they make innovation and utilize open innovation practices (Parida and others, 2012; Brunswicker & Ehrenmann, 2013). Also, their importance is increasing more and more for innovation system. For example, small companies with fewer than 1000 employees increased their R&D expenditures from 4% to 24% while R&D spending of larger companies with more than 25,000 employees decreased from 70% to 38% between 1981 and 2005 in the United States. As it is understood, R&D spending of SMEs was approximately 10 times more compared to larger companies (Chesbrough, 2010).

4.3 Structural Advantages of SMEs

SMEs have unique characteristics, which bring advantage to them compared to large companies. According to Chesbrough (2010), advantages of SMEs are size, focus, business specialization, entrepreneurial personal, and speed. Primarily, because of their smaller size, small and new markets are more attractive to SMEs in comparison with larger companies. Thus, SMEs can take advantage of trends rapidly if entry costs are low enough for them while their larger counterparts were restricted to enter small markets because of higher fixed costs, which create a barrier to be cost efficient in the competition. Moreover, compared to larger companies with dispersed objectives, focusing on markets that are more specific, customer types, or technologies enables SMEs to work very effectively. In narrow areas and niches, SMEs can become more specialized in their business. They can appeal to entrepreneurial employees. Furthermore, SMEs can react quickly, take quicker decisions and implement them rapidly because of being flexible and customer-oriented (Chesbrough, 2010).

In addition, other scholars argue that SMEs have a dynamic management style, better internal communications, and strong relationship with customers (Scozzi and others, 2005; Hutter and others, 2013). SMEs have the advantage of less bureaucracy and being flexible, which creates an innovation supporting culture when their larger counterparts tend to create a bureaucracy, which is disadvantageous to an atmosphere encouraging creativity (Laforet, 2008).

5. OPEN INNOVATION IN SMES

Chesbrough (2003a) defined open innovation using the case studies of large and experienced firms. Up to the present, open innovation has been studied mostly in high-tech multinational companies, which have large internal R&D departments. There has been limited number of research regarding open innovation in SMEs. "SMEs are the largest number of companies in an economy, but they are under-researched in the open innovation literature" (Gassmann and others, 2010). One of the most comprehensive researches regarding open innovation in SMEs belongs to van de Vrande and others (2009). Drawing on a survey database of 605 innovative SMEs in Netherlands, it was concluded that SMEs are increasingly implementing open innovation practices in their innovation process. Another finding was that SMEs primarily benefit from technology exploitation activities through initiatives and knowledge of their non-R&D workers. For technology exploration, mostly customers were involved in innovation process. Moreover, it was concluded that external networking is an important open innovation practice for SMEs to acquire missing knowledge. On the other hand, it was seen that a minority of SMEs practices outward and inward IP licensing, external participation, and venturing activities. The reason of these outcomes was explained with formality, structure and investment. The most popular practices for SMEs such as customer involvement and external networking do not require substantial investment because of being informal and unstructured practices. In contrast, outward and inward IP licensing, external participation, and venturing activities require substantial investment, formalized contracts, and structured innovation process for risk management. Another major finding was that SMEs are increasingly practicing open innovation and becoming more open.

5.1 Motives, Objectives and Constraints of Open Innovation in SMEs

Firstly, firms apply open innovation practices in their innovation process because of adapting to changing environment and tracking trends. It is clear that the knowledge landscape is very different today in comparison with past. In our day, there is a plentitude of knowledge in almost every area around us. Compared to 1970s, knowledge is more widely dispersed today. This change in knowledge landscape brings along necessity of change for organizational adaptation (Chesbrough, 2003a). Due to the fact that some other reasons such as mobile workers, wealth of venture capital and reduced product life cycles force enterprises to change, they cannot afford to innovate on their own (van de Vrande and others, 2009). In the interview-based study of Chesbrough and Crowther (2006), they concluded that enterprises do not make innovation in a different way for innovation's sake; conversely, expectation of growth in revenues and new products is primary motive to adoption of open innovation concepts. In another research, it is found that the motives to engage in open innovation practices in SMEs are mainly market-related motives. A broad set of open innovation practices are used by SMEs to serve customers effectively or to get into the new markets with major objectives to generate revenue and to provide continuity of growth (van de Vrande and others, 2009). Also, the potential motives of open innovation in SMEs are classified comprehensively by van de Vrande and others (2009) as shown in Table 5.1. Categories are given as control, focus, renewal, knowledge, costs, capacity, market, utilization, policy, and motivation.

It was seen that the market related motives are the most important determinants to engage in venturing (31%), to participate in other firms (36%) and to involve user in the innovation process (61%) for respondent companies.

On the other side, motives regarding control, focus, costs and capacity were mentioned less frequently. Another important finding was that the different innovation practices have the same motives except employee involvement (van de Vrande and others, 2009).

Table 5.1 : Classification of open innovation motives in SMEs (van de Vrande and others, 2009).

Category	Description
Control	Increased control over activities, better organization of complex processes
Focus	Fit with core competencies, clear focus of firm activities
Renewal	Improved product development, process innovation, market innovation, integration of new technologies
Knowledge	Gain knowledge bring expertise to the firm
Costs	Cost management, profitability, efficiency
Capacity	Cannot do it alone, counterbalance lack of capacity
Market	Keep up with current market developments, customers, increase growth and/or market share
Utilization	Optimal use of talents, qualities, and ideas of current employees
Policy	Organization principles, management conviction that involvement of employees is desirable
Motivation	Involvement of employees in the innovation process increases their motivation and commitment

Moreover, in the survey report, Chesbrough and Brunswicker (2013) explore the importance of different types of strategic objectives for large firms. These different objectives are:

- Establishing new partnerships
- Exploring new technological trends
- Identifying new business opportunities
- Accelerating time to complete R&D
- Mitigating risks of innovation projects
- Identifying new business opportunities
- Reducing R&D costs per project

After analyzing the survey, Chesbrough and Brunswicker (2013) found that establishing new partnerships are the most important objectives and drivers for innovation. On the other hand, reducing R&D costs per project is not considered an important objective by large firms. In this study, importance of these all objectives will be explored for SMEs.

On the other hand, SMEs face a lot of constraints when they engage in open innovation practices in their innovation process. In the open innovation literature, there are limited numbers of studies regarding constraints of open innovation.

In the paper, of which aim is to advance understanding of the process of knowledge transfer in strategic alliances, it is found that partner specific variables, such as cultural distances and organizational distances, are related to knowledge ambiguity that in turn negatively affects knowledge transfer (Simonin, 1999). Similarly, van de Vrande and others (2009) argue that the most important constraints to open innovation result from similar causes, including both cultural and organization problems. Besides, effective adoption to open innovation practices necessitates defeating two crucial challenges that are not invented here syndrome (NIH) and lack of internal commitment (Chesbrough & Crowther, 2006). Katz and Allen (1982) describe NIH syndrome as *"*tendency of a project group of stable composition to believe it possesses a monopoly of knowledge of its field, which leads it to reject new ideas from outsiders to the likely detriment of its performance.*"* and they also argues that NIH is a critical barrier for external knowledge acquisition. While NIH syndrome relates to negative manners towards technology exploration, companies may also have negative manners towards technology exploitation, leading to only used here (OUH) syndrome (Herzog & Leker, 2010). It is clear that managing open innovation practices is more complex and difficult than managing closed innovation and it requires critical organizational, financial, and human resources. Narula (2004) argues that SMEs are constrained by their limited resources because of their small size. Gruber and Henkel (2006) also claim that small firms have difficulties related to their smallness and newness as shown in Table 5.2.

Liability to smallness is stated as having few personnel and financial resources. Although smallness allows new ventures freedom in their business, limited availability of resources restricts them. Due to lack of financial resources, small firms cannot resist unfavorable business conditions and they can suffer from even minor inefficiencies (Gruber & Henkel, 2006). In the study of van de Vrande and others (2009), the finding, which is in line with the previous argument, is that medium-sized enterprises adopt and implement open innovation practices more often than small enterprises. Medium-sized enterprises put required scale and resources in order on the purpose of organizing innovation activities and they can be considered

as mine of knowledge that can be outsourced purposively in comparison with small enterprises.

Table 5.2 : Key challenges for new venture management (Gruber and Henkel, 2006).

Newness of the Firm	**Smallness of the Firm**
Unknown organizational entity	Very limited financial resources
Lack of trust in the abilities and offerings	Few human resources
Reliance on social interactions among strangers	Lack of critical skills
Lack of exchange relationships	Limited market presence
Lack of internal structures, processes/routines	Limited market power, disadvantage in negotiations
Lack of experience	
Lack of historical data for planning purposes	

On the other side, *liability to newness* occurs if the firm is lacking in organizational structure and has deficiencies regarding firm-specific roles, task and capabilities. Under these circumstances, new firms are in disadvantageous position compared to mature firms (Gruber & Henkel, 2006).

Chesbrough (2010) makes a mention of structural deficiencies of SMEs regarding open innovation and touches on difficulties related to absorptive capacity, absorbing external ideas and technologies, partnerships and intellectual property rights.

Having adequate absorptive capacity is crucial especially for technology exploration. Cohen and Levinthal (1990) define absorptive capacity as "*the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends*". According to Chesbrough (2010), SMEs frequently do not have the ability to support dedicated personnel and resources to identify useful external knowledge. Even external ideas and technologies are identified and transferred in the beginning; SMEs typically do not have the ability to absorb external ideas and technologies as well. Most of the SMEs do not have personnel with sufficient scientific background to understand, absorb and exploit the scientific discoveries and technologies, which are developed at research laboratories, universities or inside large companies. Nevertheless, Spithoven and others (2010) argue that SMEs can get over this problem through benefiting from third party technology intermediaries,

which can help SMEs out with supporting their ability to investigate the market for emerging technologies and develop their ability to absorb technologies. Additionally, third party technology intermediaries help SMEs out with performing complementary R&D activities such as business intelligence, technology road mapping, enabling networking by identifying potential partners, or facilitating collaboration with external partners (Spithoven and others, 2010).

Moreover, SMEs run into difficulties when they make partnerships with others. Firstly, in asymmetric partnerships, it is possible that small companies get into a scrape. Secondly, external networking with other SMEs, universities or research laboratories can cause to difficulties for SMEs. According to Minshall and others (2010), if one of the partners is an inexperienced start-up, which attempts to exploit a novel technology when it is not completely ready and the other partner is a long-established, complex organization, the crunch comes for the start-up. Minshall and others (2010) as shown in the Figure 5.1 indicate most common collaboration challenges in asymmetric partnerships that are experienced by small companies.

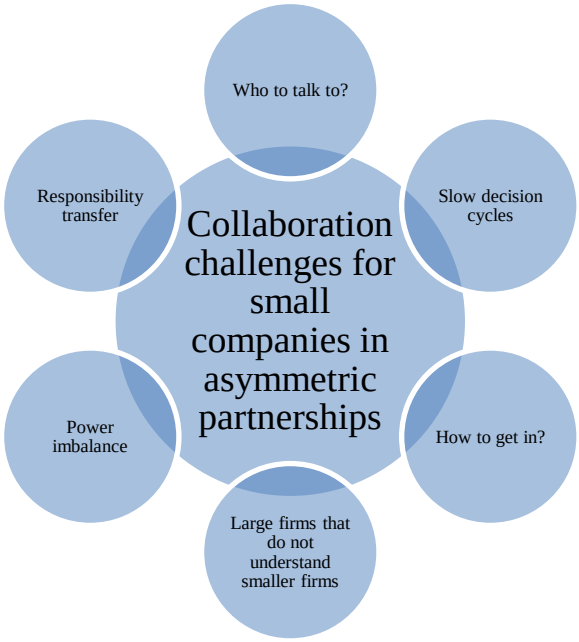

Figure 5.1 : The most common collaboration challenges for small companies in asymmetric partnerships (Minshall and others, 2010).

To communicate with the right person at the right time is not easy for the small firms in asymmetric partnerships because of the fact that large firms are complex organizations with operation spread over multiple geographic locations and that makes communication difficult. Because of the same reason, large firms have large

business scales and multi-layered management systems and start-ups may be slow in decision-making. In addition, concerns on perceptions of the importance of partnership were discussed and it was seen that collaboration is crucial for start-ups in comparison with larger companies. Also, start-ups may have problems regarding differences between organizational cultures. According to van de Vrande and others (2009), external barriers for SMEs arise from organizational, cultural and communicational differences. Finally, transferring of responsibilities of contract negotiations from the larger company's R&D department to legal and procurement department can be a major obstacle owing to the fact that R&D department speaks a similar language with start-up generally but legal and procurement department may have difficulty in understanding business operations of start-up.

Because of experienced difficulties with large companies, SMEs may be in tendency to prefer networking with other SMEs, academy or research laboratories. However, SMEs are frequently seen as unattractive partners by universities, and research organizations and most of the universities and research organizations prefer to collaborate with larger and well-known enterprises (Chesbrough, 2010).

Besides, protection of intellectual property is essential to SMEs. They have to protect their intellectual property rights from larger and richer companies, but they also need to be open to external environment because of the reasons such as raising their capital, hiring competent employees and attracting customers etc. Additionally, ability to protect intellectual property can be limited for SMEs due to their economic dependence on large companies. Thus, SMEs may be stuck in a difficult situation. On the other hand, SMEs frequently do not have the market power for capturing the value of externally sourced knowledge if not protected by IPRs (Chesbrough, 2010).

In the study entitled as "Open Innovation in South African SMEs", barriers to using open innovation in the organization were listed by Krause and others (2012) as shown in the Table 5.3.

The study demonstrates that organization/culture and administration are the main barriers for South African SMEs, respectively. On the other side, intellectual property was not rated as a major barrier although it has been mentioned a lot as a major barrier in the literature (Krause and others, 2012).

Table 5.3 : Barriers to using open innovation in the organization for SMEs (Krause and others, 2012).

Barriers to OI	**Explanation**
Finance	Obtaining financial resources
Resources	Cost of innovation, time needed and human resources needed
Organization/ culture	Balancing innovation and daily tasks, communication problems, aligning partners, organization of innovation
Knowledge	Lack of technological knowledge, lack of competent personnel, lack of legal/administrative knowledge
Marketing	Insufficient market intelligence, market affinity, marketing problems with new products
Administration	Bureaucracy, administrative burdens, conflicting rules
Quality of Partners	Partners does not meet expectations, deadlines are not met
Idea Management	Employees have too many ideas, no management support, no formal process for innovation
Customer demand	Customer demand too specific, innovation appears not to fit the market
Commitment	Lack of employee commitment, resistance to change
Intellectual Property Rights	Ownership of developed innovations, user rights when different parties corporate
User acceptance	Adoption problems, customer requirements misjudged
Competent employees	Employees lack knowledge/competences, not enough labor flexibility
Other	

In the study regarding challenges in adopting open innovation strategies in SMEs, Rahman and Ramos (2013) classify constraints to open innovation with variables comprehensively as shown in Table 5.4.

The research of Rahman and Ramos (2013) observes that there are three aspects within the constraints that a firm faces during its business process. These aspects are human aspects, general constraints and policy constraints. According to the results of the study, scarcity of skilled manpower in terms of human aspects, lack of skilled manpower in terms of general constraints and high cost of open innovation in terms of policy constraints are the major challenges for SMEs (Rahman and Ramos, 2013).

Table 5.4 : Classification of open innovation constraints in SMEs (Rahman and Ramos, 2013).

Human Aspects	**General Constraints**	**Policy Constraints**
Scarcity of skilled manpower	Lack of market demand (Low purchasing power of customer)	High cost of open innovation
Scarcity of non-skilled manpower	Lack of skilled manpower	Lack of financing
Low image of the profession	Too expensive manpower	High economic risk
Low image of the sector	Lack of quality management personnel	Organizational rigidities
Low image of the type of enterprise	Problems with administrative regulations	Government regulations
Wage levels too expensive	Problems with infrastructure (e.g., electricity, gas, communication, etc.)	Lack of customers' responsiveness
Unpleasant work	Problems with access to finance (other than interest rates)	Lack of knowledge to use new technology
Unpleasant working conditions	High interest rates	Lack of information on market
	Lack of knowledge in implementing new form of technology	
	Lack of knowledge in implementing new form of organization	
	Difficult to protect intellectual property	

Also, they explore the actions to compensate the barriers regarding competition. These actions are:

- Increasing quality of product/service
- Increase product differentiation
- Looking for market niches
- Increasing marketing activity
- Reducing costs of production
- Forming strategic partnerships
- Reducing prices of products

- Increasing working hours
- Looking for other foreign markets
- Reducing production

The study finds that the most preferred actions, which are the SMEs taking to tackle the challenges are increasing product differentiation and forming strategic partnerships (Rahman and Ramos, 2013).

Savitskaya and others (2010) explore open innovation constraints for two facets of open innovation in China. According to results of the study, main barriers to inbound open innovation and outbound open innovation are shown in the Table 5.5.

Table 5.5 Barriers to Inbound Open Innovation and Outbound Open Innovation (Savitskaya and others, 2010).

Table 5.5 : Barriers to inbound and outbound open innovation (Savitskaya and others, 2010).

Barriers to Inbound Open Innovation	**Barriers to Outbound Open Innovation**
Not-invented-here (NIH) syndrome	Not-sold-here (NSH) syndrome
No adequate technologies on offer	Complexity of IPR, fear of infringements
Takes too much time/resources	The difficulty of finding buyers
Fear of losing own innovation ability	Lack of marketplaces for technologies

The study finds that lack of adequate technologies on offer is most frequently perceived as a barrier to inbound open innovation. Thus, this finding reflects that technology markets in China are underdeveloped. On the other hand, fear of losing own innovation ability is least frequently perceived as a barrier. Moreover, complexity of IP rights and fear of infringements is the most frequently selected barrier to outbound open innovation by the firms. However, lack of marketplaces for technologies is the least selected barrier to outbound open innovation.

6. SCIENCE PARKS

Innovation is the most significant determinant regarding competitive superiority of each country. One of the most important tactics of developed and developing countries is fostering university-industry cooperation in an effort to promote innovation and increase the innovation performance (Yalçıntaş Gülbaş, 2011). It is clear that a tripod is needed to encourage innovation and entrepreneurship nationally. Universities are the institutions in which knowledge is created and disseminated to community. Companies generate added value and increase the wealth of its community. The government provides an environment for universities and industry to be in cooperation with each other. As it is understood, science parks have arisen from the relationships between the university, industry and government (Yalçıntaş, 2014).

The naming of science parks varies by country such as technology park, technopark, technopolis, research park, technology development zone, technology development center, technology corridor, innovation center and incubator.

Because of the fact that economic and social conditions vary by country, definitions of science parks differs from each other in terms of organization, objectives, services they offer, and the administrative structures. Therefore, it is difficult to make a single and comprehensive definition for science parks. Some of the different definitions resulting from these different implementations are given below;

Definition of the International Association of Science Parks (IASP, 2014):

> An organization managed by specialized professionals, whose main aim is to increase the wealth of its community by promoting the culture of innovation and the competitiveness of its associated businesses and knowledge-based institutions. To enable these goals to be met, a Science Park stimulates and manages the flow of knowledge and technology amongst universities, R&D institutions, companies and markets; it facilitates the creation and growth

> of innovation-based companies through incubation and spin-off processes; and provides other value-added services together with high quality space and facilities. (IASP, 2014)

According to General Director of IASP, Luis Sanz:

> A science or technology park is a space, physical or cybernetic, managed by a specialized professional team that provides value-added services, whose main aim is to increase the competitiveness of its region or territory of influence by stimulating a culture of quality and innovation among its associated businesses and knowledge-based institutions, organizing the transfer of knowledge and technology from its sources to companies and to the market place, and by actively fostering the creation of new and sustainable innovation-based companies through incubation and spin-off processes. (IASP, 2014)

According to the definition of United Kingdom Science Park Association (UKSPA, 2014):

> A science park is a business support and technology transfer initiative that:
>
> - Encourages and supports the start-up and incubation of innovation-led, high-growth, knowledge-based businesses.
> - Provides an environment where larger and international businesses can develop specific and close interactions with a particular center of knowledge creation for their mutual benefit.
> - Has formal and operational links with centers of knowledge creation such as universities, higher education institutes and research organizations. (UKSPA, 2014)

According to the law no. 4691 on Technology Development Zones:

> Technology Development Zones: shall refer to a site where academic, economic and social structures become integrated or a technopark which has these characteristics, where, by benefiting from the opportunities of a particular university or higher technology institute or R&D center or institute, companies using high/advanced technology or companies that aim at new technologies produce/develop technology or software, where the companies work to transform a technological invention into a commercial product, method or service, thus contributing to the development of the zone, which is in the premises or close to the same university, higher technological institute or the R&D center or institute. (WIPO, 2014)

Most emphasized points in the definition of science parks in the literature are listed below (Research and Investigation Report, 2009).

- All denominations were formed by combining of concepts such as “technology”, “science”, and “research” with concepts representing space such as “park”, “center” and “city”.

- Science parks surely must have contact with a university or research center.
- R&D and innovation-based entrepreneurs are indispensable for science parks.
- Various support mechanisms are available in the majority of science parks. However, supports are not the only reason that makes science parks attractive to firms. The synergy of the environment is also an important cause of attraction.
- Science parks aim to support the development of entrepreneurs, the region and the country through commercialization of knowledge.

Technology development is provided in different ways throughout history. In this context, two different historical examples can be mentioned. First one is the city model, which has emerged around the major economic centers. Manchester in 1770, Detroit in 1900 and Glasgow in 1950 are shown as examples of such technological developments. These examples, which are considered as excellent, laissez-faire cities were not based on the planned process consciously; they were the areas of technology development activities carried out on the basis of individual invention. The second example is the metropolitan cities, in which traditional artisan skills are combined with new commercial demands. Berlin that was considered as Silicon Valley of the period between 1800 and 1914 is a classic example of metropolitan city. Then, these examples lost their advantage over the places that develops advanced technology (Research and Investigation Report, 2009).

The first science center, Silicon Valley, was established in an attempt to develop university-industry-government cooperation in the United States of America in 1950. Silicon Valley is the most known science park all around the world and embodies many international companies such as Apple, Facebook, Microsoft, Google, Intel, LinkedIn, Twitter, Yahoo etc. (Research and Investigation Report, 2009).

6.1 Science Parks in the World

Because of international recession in the 1970s, advanced industrial countries such as Japan and the United States planned to overcome this crisis through focusing on R&D and technology investments. These economies offered better quality and cheaper products to market due to the fact that they provided university-industry cooperation perfectly. In the United States, universities, which took out averagely

250 patents per year before 1980s took out 3278 patents, developed 527 new products, established 627 spin-off companies in 2005 (Yalçıntaş, 2014).

Examples of the first science parks in the USA are Research Triangle Park that was established in North Carolina State in 1959, Route 128 that was built around Massachusetts Institute of Technology (MIT) and Silicon Valley near Stanford University in California (Kutlu Gürsel, 2007).

Positive developments in Tsukuba Science City in Japan led to the emergence of science park dissemination program in 1980. In China, science park program that is implemented in cooperation with international organizations such as UNDP and UNFSTD is known as one of the most successful science park program in the world. Multimedia Super Corridor (Malaysia) and Singapore Technology Corridor (Singapore) can be given as other examples from Far East (Töreli, 1991).

In Europe, also, a huge unemployment problem arose due to collapse of traditional industries after economic crisis. Hence, development of advanced technology has become necessary. Thus, mainly including England and Germany, many European countries have established technology development centers on the purpose of supporting entrepreneurs and transferring technologies from university to industry (Töreli, 1991).

Establishment periods of science parks in the world are shown in the Table 6.1.

Table 6.1 : Establishment periods of science parks in the world (IASP, 2007).

Period	**%**
1950s	1
1960s	1
1980s (1st period)	11
1980s (2nd period)	23
1990s (1st period)	18
1990s (2nd period)	17
2000-2006	26
Undefined	3
Total	**100**

6.2 Science Parks in Turkey

Unlike many developed countries, Turkey has met with the concept of science park too late. For the first time, technology policy in Turkey took place in the Fourth Five-Year Development Plan in time period of 1979-1983. In 1989, State Planning Organization (SPO) has been appointed to establish science parks (Research and Investigation Report, 2009). The legislative regulation has been provided for science parks in Turkey with the law of 4691 Technology Development Zones that was effectuated in 2001 and Technology Development Zones Implementing Regulation that was effectuated in 2002 (Tgbd.org.tr, 2015). This legal regulation enabled Turkey to make new technological researches in universities, technology transfer and commercial new products. Because of the fact that Turkey focuses on traditional production rather than industry-focused initiatives, country cannot gain competitive advantage based on cheap labor anymore. Therefore, especially universities and many industrial enterprises has given more importance to science parks since 2003 (Yalçıntaş, 2014).

In Turkey, 59 science parks have been established up to September 2014. Figure 6.1 illustrates the number of science parks in Turkey by year.

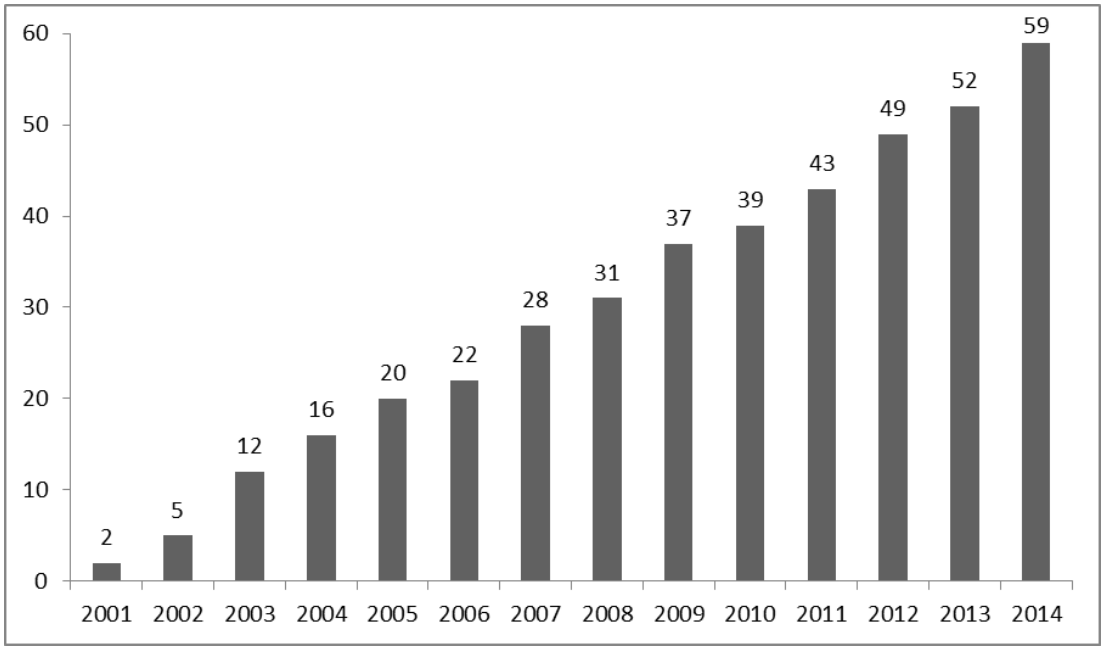

Figure 6.1 : The number of science parks in Turkey by year (sagm.sanayi.gov.tr, 2014).

41 of 59 science parks continue to operate. Table 6.2 shows all operating science parks in Turkey. Owing to the fact that infrastructure works are still ongoing in 18 science parks, they are not in operation. List of the non-operating science parks in Turkey can be found in Appendix B.

Table 6.2 : Operating science parks in Turkey (sagm.sanayi.gov.tr, 2014).

	Science Park (Technology Development Zone)	University	City	Establishment Date
1	METU Technopolis	METU	Ankara	2001
2	TUBITAK Marmara Research Center Technopolis	TUBİTAK-TTGV	Kocaeli	2001
3	Ankara	Bilkent University	Ankara	2002
4	İzmir	İzmir Institute of Technology	İzmir	2002
5	GOSB Technopark	Sabancı University	Kocaeli	2002
6	Hacettepe University	Hacettepe University	Ankara	2003
7	ITU ARI Technopolis	İstanbul Technical University	İstanbul	2003
8	Eskisehir	Anadolu University	Eskişehir	2003
9	Selçuk University	Selçuk University	Konya	2003
10	Kocaeli University	Kocaeli University	Kocaeli	2003
11	West Mediterranean	Akdeniz University	Antalya	2004
12	Erciyes University	Erciyes University	Kayseri	2004
13	Trabzon	Karadeniz Technical University	Trabzon	2004
14	Çukurova	Çukurova University	Adana	2004
15	Mersin	Mersin University	Mersin	2005
16	Lakes Region	Süleyman Demirel University	Isparta	2005
17	Ulutek	Uludağ University	Bursa	2005
18	Gaziantep University	Gaziantep University	Gaziantep	2006
19	Gazi Technopolis	Gazi University	Ankara	2007
20	Trakya University Edirne	Trakya University	Edirne	2008
21	Fırat	Fırat University	Elazığ	2007
22	Erzurum Ata Technopolis	Atatürk University	Erzurum	2005
23	Pamukkale University	Pamukkale University	Denizli	2007
24	Yıldız Technical University	Yıldız Technical University	İstanbul	2003
25	Ankara University	Ankara University	Ankara	2006
26	İstanbul University	İstanbul University	İstanbul	2003
27	Sakarya University	Sakarya University	Sakarya	2008
28	Boğaziçi University	Boğaziçi University	İstanbul	2009
29	Cumhuriyet	Cumhuriyet University	Sivas	2007
30	Dicle University	Dicle University	Diyarbakır	2007
31	Bolu	Izzet Baysa University	Bolu	2009
32	Düzce Technopolis	Düzce University	Düzce	2010
33	Malatya	İnönü University	Malatya	2009
34	Kahramanmaraş	Sütçü İmam University	Kahramanmaraş	2011
35	Dokuz Eylül	Dokuz Eylül University	İzmir	2013
36	Namık Kemal University	Namık Kemal University	Tekirdağ	2011
37	Kütahya Dumlupınar Design	Dumlupınar University	Kütahya	2009
38	Tokat	Gaziosmanpasa University	Tokat	2008
39	İstanbul	Istanbul Trade University	İstanbul	2009
40	Çanakkale	Çanakkale 18 Mart University	Çanakkale	2011
41	Samsun	On Dokuz Mayıs University	Samsun	2009

Figure 6.2 illustrates the number of companies that operate in science parks in Turkey by year.

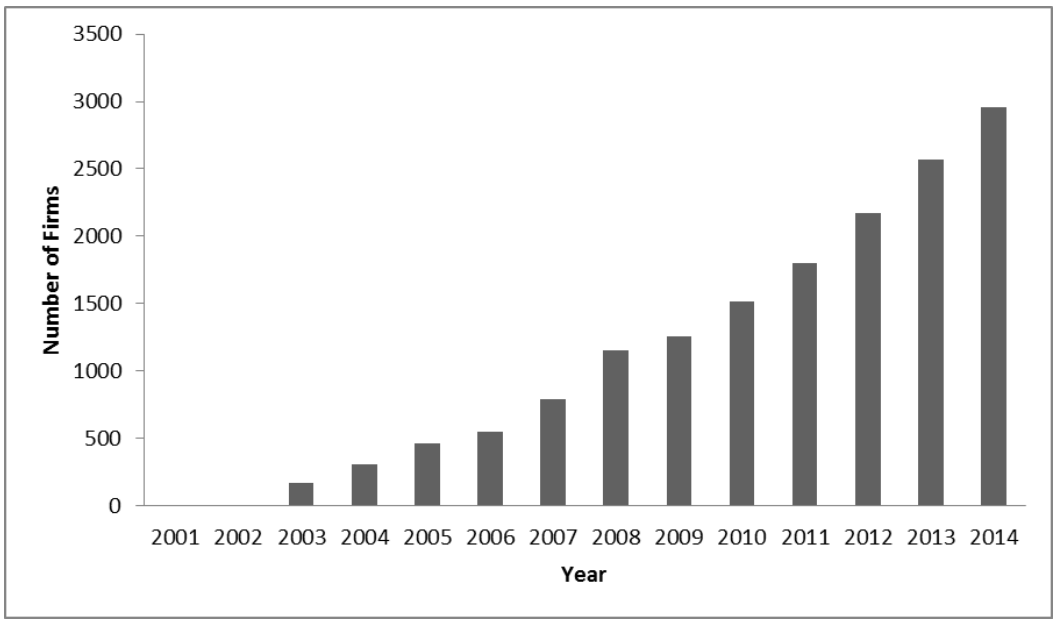

Figure 6.2 : The number of firms, which operate in science parks in Turkey by year (sagm.sanayi.gov.tr, 2014).

In today's world, one of the most important deterministic factors of competitiveness and social welfare of a country is intellectual property. Status of the companies that operate in science parks in Turkey regarding intellectual property is shown in the Table 6.3.

Table 6.3 : Status of the firms operating in science parks regarding intellectual property

	Number
Patent Registration (National/ International)	384
Patent Application (process continues)	652
Utility Model Registration	102
Utility Model Application (process continues)	29
Industrial Design Registration	18
Industrial Design Application (process continues)	5
Software Copyright (Received)	36
Software Copyright Application (Process continues)	6

6.3 Key Elements of Science Parks

According to Narasimhalu (2013), expanding triple helix model is imperative to demonstrably accept the role of venture capitalists and research laboratories although it surely made contribution to value creation process. Including angel investors, venture capital firms, and both corporate and national research laboratories as significant stakeholders of science parks is necessary. Narasimhalu (2013) calls this model as CUGAR model. C represents companies, U represents universities, G represents government, A represents angel investors and venture capitalist, and R represents research laboratories. These all are core stakeholders of science parks. Figure 6.3 illustrates the CUGAR model of Narasimhalu (2013).

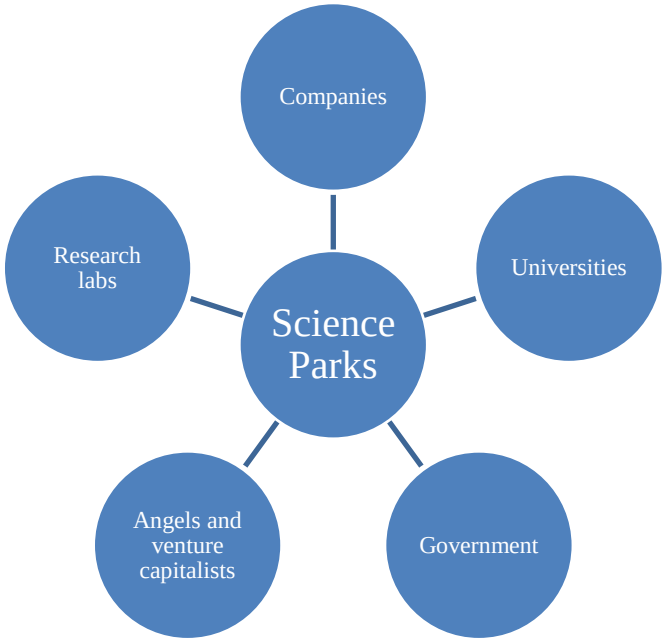

Figure 6.3 : Core stakeholders of science parks (Narasimhalu, 2013).

Successful science parks should have an enlightened management which can establish an enabling environment to prompt value creation process by using resources. Narasimhalu (2013) also extracts the critical success factors of science parks with the help of a study of large scale science parks such as St John's Innovation Center in United Kingdom and Sophia Antipolis in France. Figure 6.4 illustrates the extracted collection of critical success factors for science parks.

Science parks procure a shared area for large firms, small and medium enterprises and start-up companies. First, they can provide flexible physical resources by allowing their lessees to relocate or leave their places immediately and enabling

various configurations of place, which allow a firm to start a new life as a start-up, expand into a SME, and perhaps grow into a large company in the same place. Secondly, start-ups and SMEs absolutely need coaches, mentors and workshops which are managed by science parks although large sized firms may not need them.

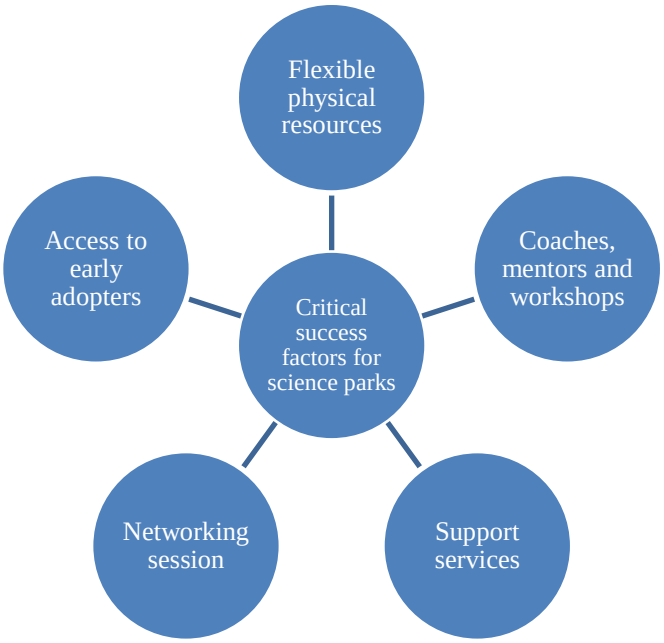

Figure 6.4 : Critical Success Factors for Science Parks (Narasimhalu, 2013).

If mentors and coaches are successful enterprises or business leaders, they can easily gain trust of the firms who seek advices of them. In addition, backgrounds of mentors and coaches should match with the industries which firms operate in. Moreover, well-organized workshops that include topics like innovation, market research and strategy can be helpful to lessees of science parks. Thirdly, support services enable a catalytic environment for all types of renters. Table 6.4 shows the relevance of support services that should be offered by science parks to their lessees.

Fourthly, there are various kinds of networking sessions and they can be between (Narasimhalu, 2013):

- Different lessees of science parks: This type of networking session provides business partnerships between different types of renters.
- IP owners and lessees: This networking session enables easy flow of intellectual property between IP owner/producer and lessees/IP consumers.
- Science and technology experts and lessees: This networking session serve as a bridge between science and technology experts and lessees of science parks.

- Lessees and target customers: It enables science park lessees to validate their ideas even before launch on development.
- Start-ups and serial entrepreneurs: This networking session is certainly necessary for science parks, which host start-ups.
- Lessees and investors: This type of networking is also so crucial. Mentioned investors are early stage and angel investors for start-ups and banks for large sized companies.

Table 6.4 : Relationship between services and firms in science parks (Narasimhalu, 2013).

Type of Service	**Relevance / Requirement**		
	Large Companies	**SMEs**	**Start-ups**
Accounting	Not very relevant	Relevant for small companies	Very relevant
Business consulting	Not very relevant	Optional	Very relevant
Food and Beverage	Very relevant	Very relevant	Very relevant
ICT infrastructure	Very relevant	Very relevant	Very relevant
Industrial design	Occasional use	Relevant	Very relevant
Intellectual property	Occasional use	Very relevant	Very relevant
Investment community	Only the banks	Banks, VCs and Pes	Early stage VCs
Legal	Not very relevant	Relevant	Very relevant
Public and media relations	Not very relevant	Somewhat relevant	Very relevant
Science and technology consulting	Occasional use	Relevant	Not relevant
Security	Very relevant	Very relevant	Very relevant
Shared lab and other facilities	Less relevant	Relevant	Most relevant
Transportation	Relevant	Relevant	Relevant

Lastly, one of the significant functions of science parks is access to early adopters that is important for all of large companies, SMEs and start-ups.

6.4 Role of Science Parks in Open Innovation

Science parks are one of the most appropriate candidates as a multifaceted connecter for open innovation across large companies, small and medium sized companies, start-ups, universities and research laboratories as illustrated in Figure 6.5.

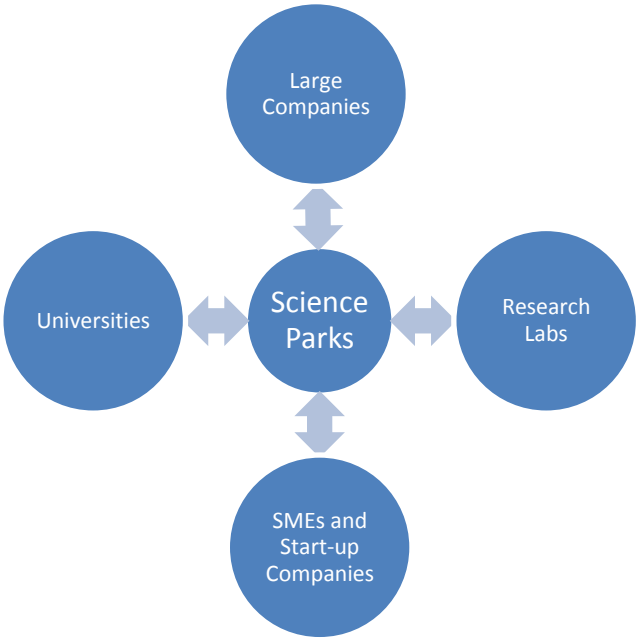

Figure 6.5 : Science Parks as Connectors for Open Innovation (Narasimhalu, 2013).

Various kinds of networking sessions that are organized by science parks provide opportunity their lessees for in licensing and out licensing of IP. Additionally, mentioned networking sessions and all others provide flow of human capital (Narasimhalu, 2013).

7. METHODOLOGY

The main objective of the study is to examine the adoption of open innovation approach in high-tech firms, which operate in science parks in Turkey. To this end, an investigation carried out:

- To determine motives of open innovation in high-tech SMEs
- To identify constraints and obstacles faced by high-tech SMEs
- To determine the necessary actions and strategies to benefit more from open innovation practices
- To promote open innovation

In today's world, making innovation within the firm's own R&D departments is not enough as an innovation strategy. It is clear that open innovation is globally known and seen as one of the most important competitive weapon. Therefore, the main research questions of the study are as follows:

- The motives to engage in open innovation practices and challenges, which are faced by firms
- The most and least preferred open innovation practices for technology-intensive SMEs
- The most and least important actions to compensate barriers on competition for technology-intensive SMEs
- Turnover and investment patterns of SMEs regarding open innovation
- The significant difference in the use of open innovation practices, the importance levels of motives to open innovation, the frequencies of encountering constraints on open innovation, the importance levels of actions to compensate barriers on competition, and the importance levels of collaborating partners during the development of innovation (These differences have been researched with respect to age of the company,

- geographical area that company operates in, target market of the firm, type of the firm, employee number and annual turnover of the firm, and duration of practicing open innovation)
- The difference in the use of open innovation with respect to developer of innovation, degree of innovation, and rate of investment on products that fall under open innovation category
- The difference in being knowledgeable with open innovation in terms of position in the organization
- Correlations between management support and being knowledgeable with open innovation of organization, between management support to open innovation and implementing open innovation more intensely, between being knowledgeable with open innovation of organization and intensity of open innovation implementation, between being sensitive to protection of intellectual property rights and practicing open innovation, between rate of investment on products that fall under open innovation category and management support to open innovation, and between rate of investment on products that fall under open innovation category and turnover from these products in technology-intensive SMEs

7.1 The Research Methodology

This study aims to focus on the open innovation practices of technology companies that are operating in science parks in Turkey.

Study explores the business performance, innovative performance, current open innovation practices and methods, motivations for applying open innovation methods, perceptions on the obstacles/constraints for open innovation in these technology companies that are operating in science parks in Turkey.

Firstly, a survey was developed in an attempt to evaluate the high tech SMEs, which operate in science parks in Turkey, in the light of information gathered from the literature. After developing the survey, an appointment from ITUNOVA TTO has gotten to consider an expert opinion. Then, survey questions were organized in line with the recommendation of the expert.

After preparing the survey, a pilot study was conducted in ITU ARI Technology Development Zone. ITU Data Collection and Statistical System (VETI) was used to publish the survey on the internet. In the sequel, survey link was e-mailed to 515 firms of 41 science parks. Those all firms operate in science parks in Turkey. 102 firms responded to our survey. Therefore, survey response rate is approximately 20%. On the other hand, we had a face-to-face interview with a firm from ITU ARI Technology Development Zone.

To analyze responses of the firms, 20.0 version of SPSS computer software was used. The statistical analysis methods that are used in the research are descriptive statistics, reliability analysis, factor analysis, difference tests, and correlation analysis. Difference tests were performed by using t-Test, ANOVA, Mann-Whitney U Test, and Kruskal-Wallis Test.

7.1.1 Structure of the survey

The survey consists of four sections: general information, innovation, open innovation and contact information. Totally, 30 questions were asked to participants.

In the first section, general business performance of the firm is aimed to research. This section consists of nine questions. Questions regarding establishment date of the firm, science park that the firm operates in, target market of the firm, activity area of the firm, type of the firm, position of the respondents in the organization, number of employees in the organization, annual turnover of the firm and sensitivity of the firm to the protection of intellectual property rights were asked to participants in this section respectively. Considering the recommendation of the expert from ITUNOVA TTO, ninth question that is about sensitivity of the firm to the protection of intellectual property rights was added to the survey.

In the second section, innovation performance of the firm is aimed to research. This section consists of seven questions. Though the scope of what is considered as innovation has been expanded to include marketing innovation and organizational innovation in Oslo Manual (2005), only questions related to product and process innovations were asked to participants due to the fact that marketing innovation and organizational innovation are not considered as technological innovations. In this section, definitions regarding innovation and innovation types were given before related questions to provide convenience to participants and these definitions were

taken from OSLO Manual (2005) and CIS Survey (2010). Additionally, first six questions were also taken from CIS Survey (2010) in order to investigate innovation performance of the participating firms. Finally, last question of innovation section was selected from the study of Krause and others (2012). However, "non-competitor firms" option was removed and "employees" and "support and incentive funds" options were added to question with the advice of the expert. Also, "suppliers" option was changed to the "suppliers and stakeholders".

In the third section, open innovation performance of the firm is aimed to research. This section consists of fourteen questions. In this section, the definitions of open innovation and facets of open innovations were provided before related questions, as well. The definitions were taken from Chesbrough (2006) and van de Vrande and others (2009). First three questions were selected from the study of Krause and others (2012). Also, the definitions of open innovation types were taken from the same study in third question. Fourth, fifth, sixth and ninth questions were taken from the Managing Open Innovation in Large Firms Survey Report by Chesbrough and Brunswicker (2013) and options were rescaled and edited. In addition, seventh and eighth questions were taken from the study of Rahman and Ramos (2013) and tenth question and definitions given before this question were taken from Krause and others (2012). These questions were also rescaled. The next two questions regarding constraints of inbound and outbound open innovations were taken from the study of Savitskaya and others (2010). Besides, thirteenth question was taken from the study of Rahman and Ramos (2013). "Low image of the profession", "Low image of the sector", and "Low image of the type of enterprise" options were removed and "Employees are reluctant to share information", "Low image of the firm" and "The high staff turnover" options were added to question. Finally, the last question was also taken from the study of Rahman and Ramos (2013).

In the fourth section, contact information of the respondent was asked. Also, whether the respondents would like us to send them research results as summary or not was asked.

In line with the recommendations of the expert;

- Scales were edited.
- A new question regarding intellectual property rights was added to survey.

- Options of some questions were removed and some new options were added to questions.
- Some typos and ambiguities were corrected.

As for the structure of the options, blanks were given to fill in for establishment date of the firm and contact information. It was required to select an appropriate option for the science park that is operated in, target market of the firm, activity area of the firm, position of the respondents in the organization, number of employees in the organization, annual turnover of the firm and some other questions related to innovation and open innovation. Besides, Likert Scale and yes/no options were used for some questions. Question table of the survey is shown in the Table 7.1. English format of the survey can be found in Appendix A.

Table 7.1 : Question table of the survey.

Question	**Scale**	**Question Number**	**Source**
Establishment Year	Nominal	G1	Researcher
Science Park	Nominal	G2	Researcher
Target Market	Nominal	G3	Researcher
Activity Area	Nominal	G4	TUBISAD, Expert from ITUNOVA TTO, Researcher
Firm Type	Nominal	G5	Researcher
Position in the Organization	Nominal	G6	Researcher
Employee Number	Ordinal	G7	Researcher
Annual Turnover	Ordinal	G8	Researcher
Sensitivity to Protection of IPR	Scale	G9	Expert from ITUNOVA TTO
Type of product innovation	Nominal	I1	CIS Survey (2010)
Developer of product innovation	Nominal	I2	CIS Survey (2010)
Degree of product innovation	Nominal	I3	CIS Survey (2010), Researcher
Type of process innovation	Nominal	I4	CIS Survey (2010)
Developer of process innovation	Nominal	I5	CIS Survey (2010)
Degree of process innovation	Nominal	I6	CIS Survey (2010)
Importance of collaborating partner	Scale	I7	Krause and others (2012), Researcher
Open Innovation Knowledge of Respondent	Scale	O1	Krause and others (2012)

Table 7.1 (continued) : Question table of the survey.

Question	Scale	Question Number	Source
Open Innovation Knowledge of Organization	Scale	O2	Krause and others (2012)
Open Innovation Practices	Scale	O3	Krause and others (2012), Researcher
Duration of practicing open innovation	Ordinal	O4	Chesbrough and Brunswicker (2013), Researcher
Intensity of open innovation implementation	Scale	O5	Chesbrough and Brunswicker (2013), Researcher
Motives to open innovation	Scale	O6	Chesbrough and Brunswicker (2013), Researcher
Investment on Open Innovation	Ordinal	O7	Rahman and Ramos (2013), Researcher
Sales revenue from open innovation	Ordinal	O8	Rahman and Ramos (2013), Researcher
Management support to open innovation	Scale	O9	Chesbrough and Brunswicker (2013), Researcher
General constraints on open innovation	Scale	O10	Krause and others (2012), Researcher
Constraints on inbound open innovation	Scale	O11	Savitskaya and others (2010), Researcher
Constraints on outbound open innovation	Scale	O12	Savitskaya and others (2010), Researcher
Constraints of human resources on open innovation	Scale	O13	Rahman and Ramos (2013), Expert from ITUNOVA TTO, Researcher
Competition regarding open innovation	Scale	O14	Rahman and Ramos (2013), Researcher

7.2 Reliability

The scale that is used for measuring tangible or intangible characteristics should be a standard measuring tool and it must have two main properties to be standardized and capable of producing appropriate information. These two properties are reliability that is an indicator of the stability of the measurement values and validity that is an indicator of correct measuring (Ercan and Kan, 2004).

Reliability is an indicator of the stability of the measurement values obtained from repeated measurements that are performed in the same conditions with a measuring tool (Ercan and Kan, 2004). In that case, a reliable test or scale gives similar results when it is applied in similar conditions repeatedly. Whether the same or similar

results can be obtained when research is made again using the same method by different researches should be asked to inquire reliability. If the answer is yes, test or scale is reliable. Because of the fact that performing an errorless measurement is not possible, reliability of the measurement can be increased through minimizing errors and the main requirement to minimize errors is to identify sources of error and bring them under control.

Psychometric studies discuss reliability analysis in four groups: Internal consistency reliability, test-retest reliability, parallel forms reliability, and inter-rater or inter-observer reliability (Ercan and Kan, 2004; Çakmur, 2012).

7.2.1 Internal consistency reliability

This method is used to determine the consistency of results across items within a scale or test. Internal consistency is an assumption that each measurement tool consists of independent units and these all units (e.g. test items, survey questions) are equally weighted in whole. In internal consistency analysis, whether items measure a conceptual structure consistently or not is investigated through a single measurement instrument. Reliable tests and survey scales have high internal consistency. There are a wide variety of approaches to calculate internal consistency. These approaches are average inter-item correlation, average item-total correlation, point-biserial correlation, and Cronbach's alpha (Ercan and Kan, 2004; Çakmur, 2012).

In average inter-item correlation, total scores of the scale are not participated in the calculation. Only, correlation analyzes is performed between each pair of items. For example, if we have 7 items we will have 21 pairs of items and calculate them. Average inter-item correlation is the average of all these 21 correlations and result of this analysis shows relationships between each item pairings.

In average item-total correlation approach, inter-item correlations are used as well. Also, total score of all seven items is computed and this result is used as eighth variable. Average item-total correlation is the average of all these 28 correlations and result of the analysis gives reliability of test or scale.

Point-biserial correlation analysis is performed on the two parts of the values and it is only used when one variable is dichotomous (e.g. gender). In this type of analysis, total point values that are continuous data and point values of which items are encoded as 1-2 or 0-1 are compared.

Cronbach's alpha coefficient method that was first named by Cronbach (1951) is used as a lower bound estimate of the reliability when the scales are Likert scales, semantic differential scales, Stapel scales, total or average score based psychometric tests, and indexes that are composite measures. According to Nunnaly (1978), 0.7 is an acceptable reliability coefficient but some studies in the literature use lower thresholds. If there is a negative correlation between questions, Cronbach's alpha coefficient is also found negative. A negative alpha leads to the deterioration of the reliability due to the fact that principle of additivity will be faulty. Descriptions of related terms are shown in the Table 7.2 (Gliem and Gliem, 2003).

Table 7.2 : Descriptions of terms regarding Cronbach' Alpha coefficient approach (Gliem and Gliem, 2003).

Term	Definition
Inter-Item correlation	Descriptive information of the correlation of each item with the sum of all remaining items.
Scale Mean if Item Deleted	All scale items are summed for respondents excluding the item listed and the mean of the summated items is given.
Scale Variance if Item Deleted	All scale items are summed for respondents excluding the item listed and the variance of the summated items is given.
Corrected Item-Total Correlation	Correlation of the item designated with the summated score for all other items.
Alpha	The most frequently used Cronbach's alpha coefficient.
Alpha if Item Deleted	It represents Cronbach's alpha reliability coefficient of the scale in case of removing the item from the scale.
Standardized Item Alpha	Cronbach's alpha coefficient when items of the scale have been standardized is used only if items aren't scaled the same.

7.2.2 Test-retest reliability

In test-retest reliability, consistency of a test or scale is indicated by similarity of the results of measurements performed at two times. Mostly, it is used in tests and scales that are wanted to standardize. After performing two measurements, correlation coefficient between these two measurements is calculated. Correlation coefficient changes between -1 and +1. If correlation coefficient approximates +1, test or scale

can be considered as reliable. This method is mostly used for attention, attitude and aptitude tests. The most critical aspect of this approach is arranging the time period. Short time period eases remembering and reliability is found high artificially. On the other hand, extended period of time makes it difficult to provide the same conditions for two measurements. It is clear that the shorter the time interval, the higher the correlation and the longer the time gap, the lower the correlation (Ercan and Kan, 2004; Çakmur, 2012).

7.2.3 Parallel forms reliability

If making the test at two different times is difficult, parallel forms reliability is used instead of test-retest reliability. However, each of the groups must be parallel to each other in terms of properties that will be measured. One difficulty of this method is generating many items, which reflect the same construct (Ercan and Kan, 2004; Çakmur, 2012).

7.2.4 Inter-rater or inter-observer reliability

Obse1rvers can evaluate a given case independently depending upon a predetermined scoring system. When given scores are similar to each other, scores can be considered as reliable. There are two ways for estimating inter-observer reliability. Firstly, the percent of agreement between all observers is calculated when the measurement comprises categories. Secondly, correlation between the scorings or ratings of two raters is calculated if the measurement is continuous and calculated correlation between these scorings may give a clue about reliability between observers (Ercan and Kan, 2004; Çakmur, 2012).

In this thesis study, Cronbach's alpha method is used for all scaled questions because of the fact that this approach is used when the scales are Likert type scales.

7.3 Validity

Even if the reliability of the measurement tool is obtained via an appropriate method, it is not enough to understand what you want to measure. In this context, this research is related to validity of measurement tool (Ercan and Kan, 2004). Validity is defined firstly in 1937 by Garret as "measurement degree of the property, which is wanted to measure, expediently" (Çakmur, 2012). According to Çakmur (2012),

validity is the lack of errors that would undermine the overall accuracy of the study and a valid test or scale should give the same result in repeated measurements. A valid scale must be reliable principally because of the fact that a valid test or scale is also reliable. However, a reliable test or scale is not always valid. Validity is assessed in four ways as content validity, face validity, criterion validity and construct validity (Ercan and Kan, 2004; Çakmur, 2012).

7.3.1 Content validity

Content validity that is a non-statistical type of validity is an indicator of whether the scale as a whole and each item in the scale serve the purpose to be measured. There are five phases of content validity: (1) defining conceptual structure or test universe, (2) revealing dimensions of conceptual structure, (3) generating scale items, (4) taking referee's opinion, and (5) analyzing. Content validity is important in terms of covering basic dimensions of conceptual structure. However, it cannot determine the limits of the conceptual structure exactly (Ercan and Kan, 2004; Çakmur, 2012).

7.3.2 Face validity

Face validity is also a non-statistical type of validity that is determined by taking opinions of researchers themselves and other individuals regarding whether a scale measures under-researched structure or not. It is clear that face validity refers to the transparency of test as seen by the test respondents. Face validity of the scale should be increased in some cases and sometimes it should be hidden (Ercan and Kan, 2004; Çakmur, 2012).

7.3.3 Criterion validity

In this type of validity, the results obtained from scale are compared with the standard measurement scale. To make comparison with the scale or test results, some multiple criteria or a standard scale of which validity and reliability analysis was conducted before are used as base. Criterion validity is not used for evaluating the results of the scales; it is used for making predictions for the future (Ercan and Kan, 2004; Çakmur, 2012).

7.3.4 Construct validity

Construct is a pattern that is composed of certain items, which are considered as related to each other or relationships between the items. Construct validity is applied when behavior areas or conceptual structure are investigated instead of a concrete measurement. Six distinguishable sub-domains of construct validity are specified by Messick (1994) as content, substantive, structural, generalizability, external, and consequential aspects through addressing primary concerns implicit in the concept of validity as a unified concept (see Table 7.3).

Table 7.3 : Messick's six principles of a unified theory of construct validity (Chiappelli, 2014).

Sub-domains	
Content	Do test items appear to be measuring the construct of interest?
Substantive	Is the theoretical foundation underlying the construct of interest sound?
Structural	Do the interrelationships of dimensions measured by the test correlate with the construct of interest and test scores?
Generalizability	Does the test generalize across different groups, settings, and tasks?
External	Does the test have convergent, discriminant, and predictive qualities?
Consequential	What are the potential risks if the scores are, in actuality, invalid or inappropriately interpreted? Is the test still worthwhile given the risks?

7.4 Factor Analysis

One of the most commonly used method to determine the construct validity is factor analysis. It was seen that there are many studies that saturate factor analysis literature with definitions, discussions, and recommendations (Loo, 1979; Tabachnick and Fidell, 2001; Büyüköztürk, 2002; Beavers and others, 2013). Factor analysis is a multivariate statistical method for obtaining a small number of definable and significant variables from a larger number of variables that measure the same structure. (Büyüköztürk, 2002). According to Tabachnick and Fidell (2001), factor analysis is a circular process that reorganizes and compares the solutions continuously until reaching most significant results to prevent complexity of further analysis. Two main objectives of factor analysis are reducing the number of variables

and uncovering some new structures by taking advantage of the relationship between variables (Özdamar, 2002). Besides the use of factor analysis for the purpose of dimension reduction by reducing the number of variables, it is also used in order to uncover unobservable and hidden dimensions between variables, specify the factors that explain the relationships between variables, ensure the validity of the structure required for various statistical models, and determine the associated variables for discriminant and regression analyzes (Patır, 2009).

Factor analysis is divided into two basic methods: exploratory and confirmatory factor analysis. Exploratory factor analysis is used to determine complex interrelationships among test items or survey questions, which are the part of a unified concept. Confirmatory factor analysis is used to test whether items of a construct are associated with the researcher's understanding of nature of the construct and it is a more complex approach in comparison with exploratory factor analysis. This thesis study focuses on exploratory factor analysis.

Basics concepts of factor analysis can be handled as follows (Tabachnick and Fidell, 2001; Büyüköztürk, 2002).

Correlation matrix: Correlation matrix that is produced by the observed variables is called as observed correlation matrix and correlation matrix that is produced by factors is called as reproduced correlation matrix. Residual correlation matrix shows the difference between observed and reproduced correlation matrix and it is related to variance that cannot be explained by factors. In a good factor analysis, residual correlations are low and low residual correlations show the consistency between observed and reproduced correlation matrix.

Eigen value: The Eigen value measures the variance in all variables that is accounted for by a given factor. When the Eigen value increases, variance explained by the factor is also increases.

Common factor variance: The following three variances may be mentioned with respect to explaining variance in factor analysis: common factor variance, specific variance and error variance. The sum of common factor variance and specific variance is used to interpret the reliability of the test. Communality is equal to sum of the squared factor loadings.

Factor loading: Factor loading is a coefficient that shows the relationship between items and factors and it is sometimes named as factor coefficient. Factor loading of an item that is included by a factor is expected to be high in that factor. Factor loading between 0.30 and 0.59 is considered as moderately high and factor loading higher than 0.60 is considered as high.

Factoring: Factor analysis can be defined as the process of factoring. Indicators of a good factoring: (1) dimension should be reduced, (2) produced new factors should be unbound and (3) obtained factors should be valuable.

There are various factoring techniques. These techniques can be divided into two groups as classical factor analysis and principal component analysis. Principal axis, maximum likelihood and multiple grouping are some of the classical factor analysis techniques. The most commonly used one among mentioned techniques is principal axis approach that is also called as principal factors in some studies. On the other hand, principal component analysis is the most used approach among all factoring techniques. While principal component analysis produces components, factor analysis produces factors.

Rotation: Rotation serves to make obtained factors more understandable, interpretable, independent, and meaningful. This operation does not change the basic mathematical properties of the solution. After rotation of the axis, factor loading of the item increases in one factor and decreases in the other one. In a good factor rotation: (1) dimension should be reduced, (2) independence between factors should be provided and (3) conceptual meaningfulness should also be provided.

As a general rule, if researcher wants to get most appropriate results to data, oblique rotation is recommended. On the other side, to obtain generalizable results, applying orthogonal rotation is better. The fact remains that orthogonal rotation is more preferred owing to the fact that it is easy to interpret and both rotations provide almost the same results. Also, researchers often choose varimax or quartimax techniques for orthogonal rotation and oblimin or promax techniques for oblique rotation. If the construct is believed to be multi-factor, varimax technique will be more appropriate choice. In case of applying oblique rotation, promax is recommended in comparison with oblimin to get more usable results in the future.

Kaiser-Meyer-Olkin measure of sampling adequacy: The data must first be tested whether it is appropriate for factor analysis. One of these tests is Kaiser-Meyer-Olkin Measure of Sampling Adequacy. According to Field (2000), the lower limit of KMO should be 0.50. Interpretation guideline suggested by Kaiser, Meyer and Olkin is shown in the Table 7.4 (Beavers and others, 2013).

Table 7.4 : Interpretation guidelines for the Kaiser-Meyer-Olkin Test (Beavers and others, 2013).

KMO Value	Degree of Common Variance
0.90 to 1.00	Marvelous
0.80 to 0.89	Meritorious
0.70 to 0.79	Middling
0.60 to 0.69	Mediocre
0.50 to 0.59	Miserable
0.00 to 0.49	Don’t Factor

Pure and complexity variable: In the event that a variable is associated with only one factor, that variable is called as pure variable. On the other hand, the variable that is associated with more than one factor is called as complexity variable (Tabachnick and Fidell, 2001).

Sample size: How large the sample should be to produce a reliable factor analysis solution is a significant question that comes to mind. The related literature includes too much information in response to this question. It is indicated that in the literature, sample size between 100 and 200 is enough for factor analysis. According to Tabachnick and Fidell (2001), provided that sample size is greater than number of variables, sample size may be agreed as 50.

8. FINDINGS

The general reliability of the survey for all scaled questions is 0.859 while using Cronbach's alpha model that is used as a lower bound estimate of the reliability and was first named by Cronbach (1951). According to Nunnaly (1978), 0.7 is an acceptable reliability coefficient but some studies in the literature use lower thresholds. In this case, our survey is reliable and we can continue with further analysis.

8.1 Charasteristics of the Participant Firms

In order to reveal responses given by participants as a summary, characteristics of the participant companies are given.

8.1.1 The year of establishment of the company

In the survey, establishment years were asked to companies firstly and the responses given by the respondents are shown in the Table 8.1.

Table 8.1 : Establishment year of the company.

Establishment Year of the Company	Frequency	Percent
Before 1990	5	4,90
1990-1994	5	4,90
1995-1999	4	3,92
2000-2004	14	13,73
2005-2009	25	24,51
2010-2014	49	48,04
Total	102	100,00

According to the responses taken from participants, the oldest company was founded in 1896 and the newest company was founded in 2014. It is clear that most of the companies were founded after 2009 and we can say that most of the participating firms were founded within the last 5 years (see Figure 8.1).

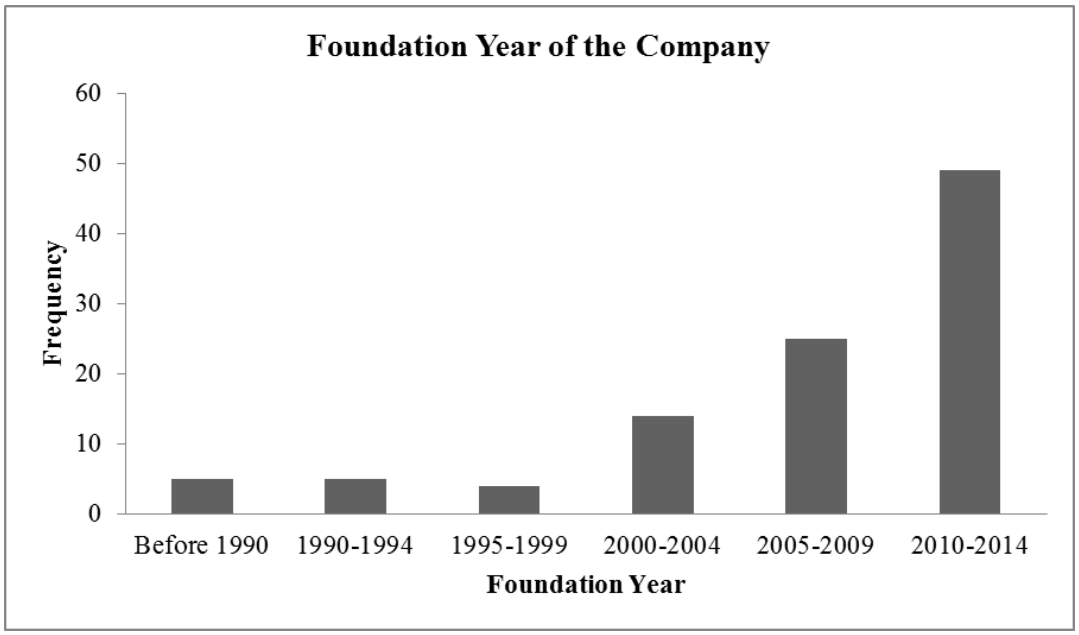

Figure 8.1 : Establishment Year of the Company.

8.1.2 Science park (technology development zone)

The survey was e-mailed to firms, which operate in 41 science parks in Turkey. However, none of the firms that operate in Bogazici University Technology Development Zone, Bolu Technology Development Zone, Duzce Technopark Technology Development Zone, Firat Technology Development Zone and Tokat Technology Development Zone participated in the survey. Firms that take part in the survey mostly operate in ITU ARI Technology Development Zone, Selcuk University Technology Development Zone, and METU Technopolis Technology Development Zone respectively. Only one firm participated in the survey from the 14 technology development zones (see Figure 8.2).

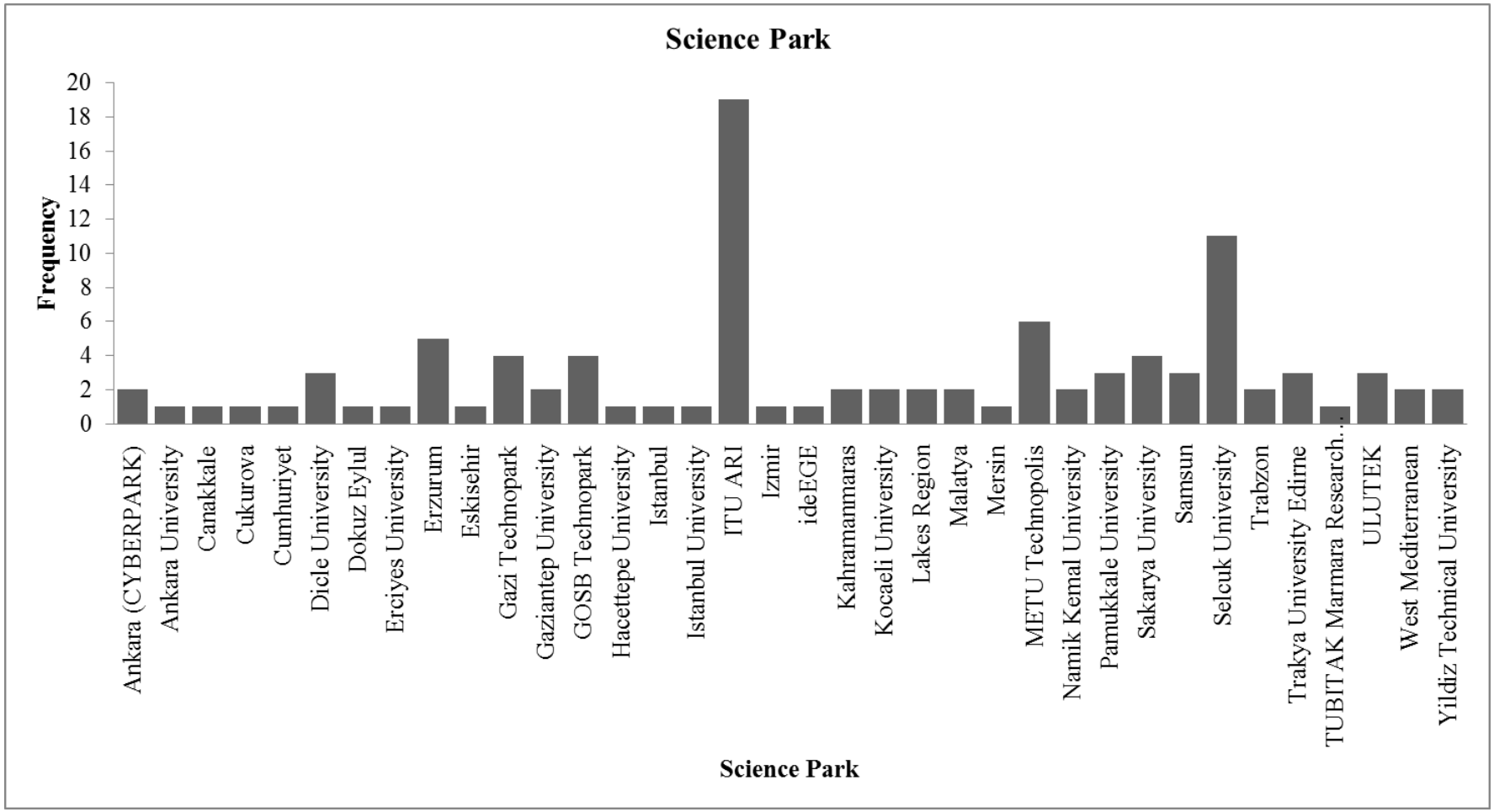

Figure 8.2 : Science Park that Companies Operate in.

8.1.3 Target market

Target markets of the companies are shown in Figure 8.3. Target market of the firms, which participated in the survey is mostly both internal and external market. The firms, which selected both internal and external market as option, have a percentage of 77.5% of all participants. Secondly, 22 of 102 companies target only internal market with 21.6%. On the other hand, there is only one company, which targets only foreign markets with 1%.

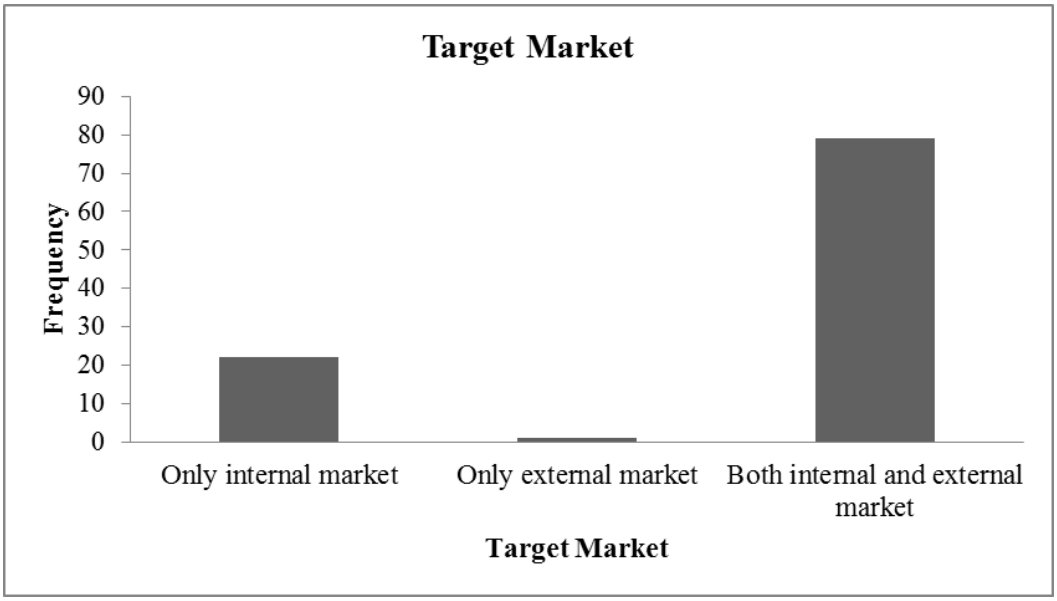

Figure 8.3 : Target Market of the Company.

8.1.4 Activity area

Due to the fact that focusing on technology intensive firms was intended, the classification that was made by TUBISAD Informatics Industry Association for their members was used in determining the activity areas in the survey. In the classification of TUBISAD, there are five member activity areas. They are hardware, software, IT services, telecommunication operators, and digital media (see Table 8.2).

After receiving opinion of the expert from ITUNOVA TTO, activity areas were organized. Hereby, the new options of the question regarding activity area of the firm are software, hardware, digital mobile media, telecommunication technologies, audio and video processing technologies, and other.

Table 8.2 : Member activity areas (TUBISAD, 2014).

Activity Area	
Hardware	Production, distribution, retail
Software	Development, packaged software
IT services	Call center, system integrator, consulting, hardware support, software support, training, service supplier
Telecommunication operators	
Digital media	

Because of the fact that a company may have more than one activity area, more than one option could be selected by respondents. Frequencies of activity areas are shown in Figure 8.4. 78 of total companies operate in software with 76.5%. In that case, a large majority of participating firms are engaged in software business. 26 of total companies operate in hardware with 25.5%, 11 of total companies operate in digital mobile media with 10.8%, 22 of total companies operate in telecommunication technologies with 21.6%, 13 of total companies operate in audio and voice processing technologies with 12.7%, and 27 of total companies operate in other areas with 26.5%.

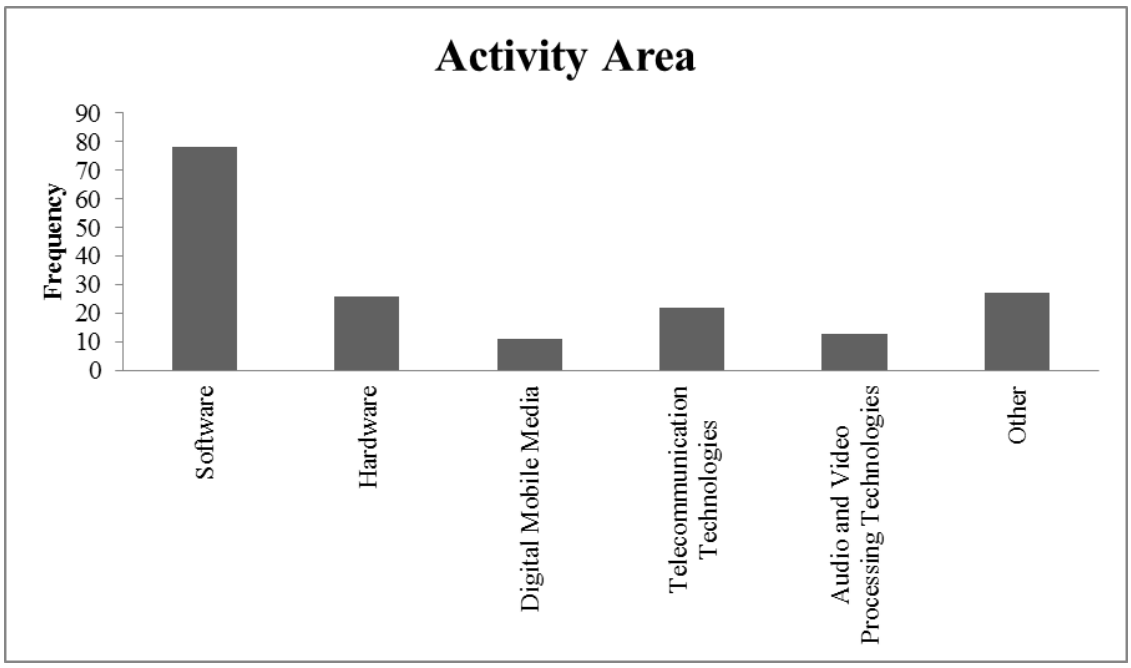

Figure 8.4 : Activity Area of the Company.

Participants were asked to indicate their activity areas, if they selected only "other" option. 11 participants stated that they operate in other areas. Activity areas specified

under “other” are shown in the Table 8.3. 5 of the 11 respondents operate in the field of biotechnology and other companies operate in the fields of IT services, textiles, apiculture, electronics, renewable energy resources, and machine manufacturing.

Table 8.3 : Other activiy areas.

Other Activity Areas	**Frequency**	**Percent**
IT Services (Consulting)	1	9,09
Biotechnology, Dental and Medical Devices	5	45,45
Textiles	1	9,09
Apiculture	1	9,09
Renewable Energy Resources	1	9,09
Electronics	1	9,09
Machine Manufacturing	1	9,09
Total	11	100

8.1.5 Type of the firm

According to results, 95 of the 102 companies are independent companies with 93%. On the other side, approximately 7% of all respondents are subsidiary companies that are partly or wholly owned by a holding company.

8.1.6 Position in the organization

All participants are from executive level. Frequencies of positions in the organization are shown in Figure 8.5. Positions of the respondents are company owner, manager, specialist/engineer or administrative/support staff. A large part of the respondents who answered the survey is company owner with approximately 56%. Managers with 35.3% and specialists/engineers with 6.9% respectively follow company owners. Only two of 102 participants are administrative/ support staffs with 2%.

Figure 8.5 : Position in the Organization.

8.1.7 Number of employees

Because of the fact that respondents were selected from technology intensive small companies that operate in science parks, numbers of employees in most companies are less than 250. Figure 8.6 illustrates frequencies of employee numbers in participating companies. As expected, more than half of the participating firms have less than 10 employees with approximately 54 and 7% of all participating firms have more than 250 employees.

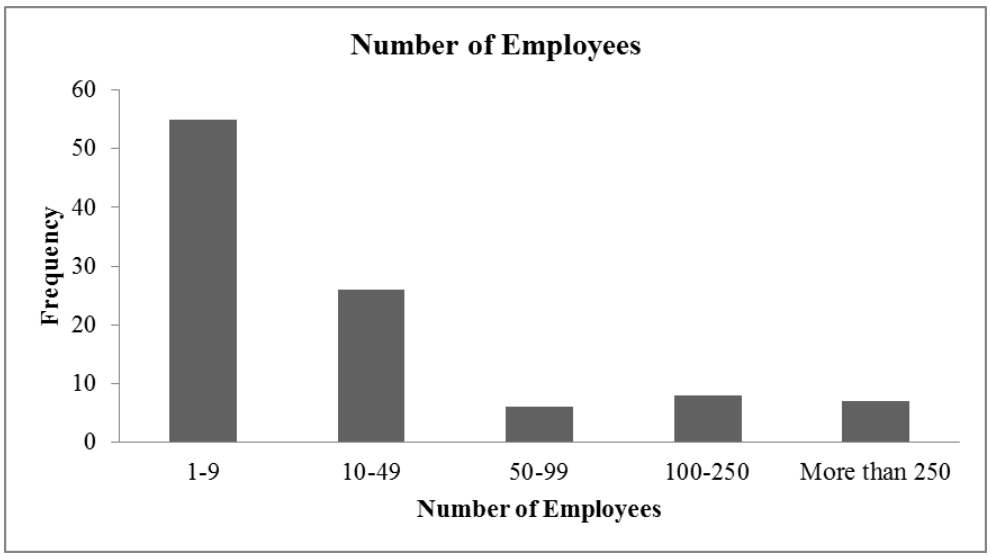

Figure 8.6 : Number of Employees.

8.1.8 Annual turnover of the firm

Approximately 63% of the firms have annual turnover less than 1 million TL. On the other hand, annual turnover of 3% of the respondents is more than 40 million TL. Figure 8.7 shows annual turnovers of all participating companies. Considering annual turnovers of companies, we can say that most of the respondents are micro, small and medium-sized enterprises.

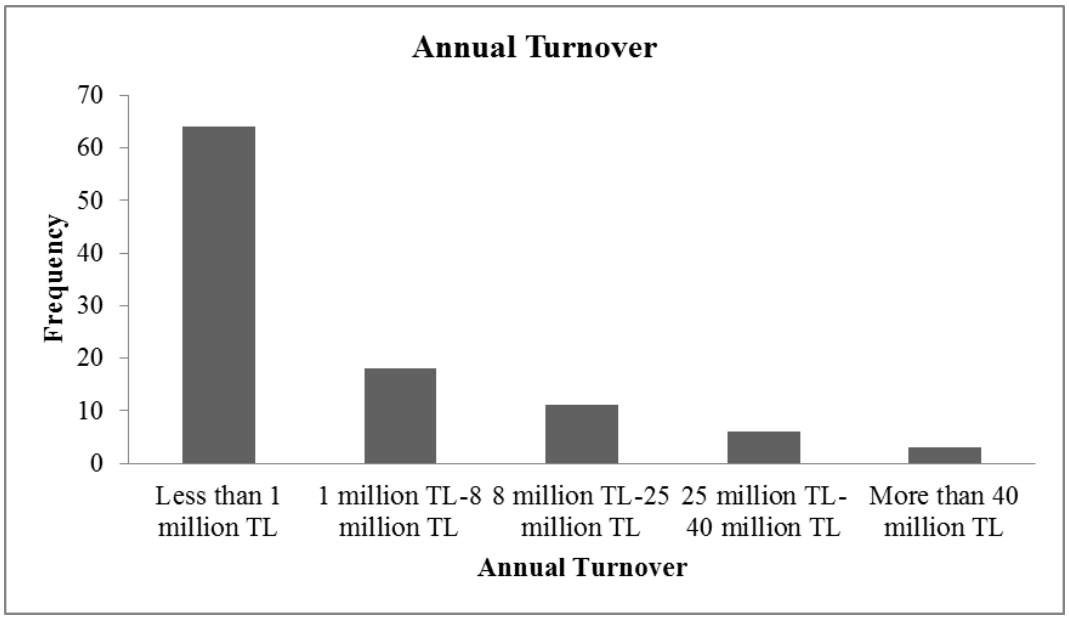

Figure 8.7 : Annual Turnover of the Firm.

8.1.9 Sensitivity to protection of intellectual property rights

A question was asked to participants to understand sensitivity level of the firms to protection of intellectual property rights. Respondents were asked their level of agreement or disagreement on 5-Likert Scale where 5 stands for total agreement and 1 stands for total disagreement. Mean is 4.39 and standard deviation is 0.834. Thus, most of the respondents are sensitive to protection of intellectual property rights (see Table 8.4).

Table 8.4 : Sensitivity to protection of intellectual property rights.

	N	Mean	Std. Deviation
Sensitivity to IPR	102	4,39	,834

8.1.10 Product and process innovation

Before asking questions about open innovation, innovativeness levels of the participants were questioned. In the survey, questions and options in CIS SURVEY (2010) regarding innovation were used because of the fact that it is based on Oslo Manual (2005) that is the primary international basis of guidelines to define innovation and innovation activities. Moreover, due to the fact that definitions regarding product innovation and process innovation in Oslo Manual (2005) are directly associated with the concept of technological product and process innovation and the survey was conducted to technology intensive companies; these definitions were given before the related questions. Although the scope of what is considered as innovation has been expanded to include two new types of innovation (marketing innovation and organizational innovation) in Oslo Manual (2005), questions related to marketing innovation and organizational innovation were not asked in the survey owing to the fact that they are considered as non-technological innovations.

Table 8.5 shows the general descriptive statistics related to making product and process innovation. It is clear that 84.3% of all respondents introduced both product and process innovation during the three years 2012 to 2014. In addition, 9.8% of the participating firms introduced only product innovation and 4.9% of them introduced only process innovation. On the other hand, only one firm introduced neither product innovation nor process innovation during last three years.

Table 8.5 : Product and process innovation.

	Frequency	**Percent**
Only product innovation	10	9,8
Only process innovation	5	4,9
Both product and process innovation	86	84,3
None of them	1	1
Total	102	100,0

8.1.10.1 Product innovation

During the three years 2012 to 2014, whether the company introduced a product innovation or not was questioned and the question was asked separately for both good and service innovations. Table 8.6 shows whether respondents introduced new or significantly improved goods and services or not in the last three years. Most of

the respondent firms introduced both good and service innovations with 41.2%. 20.6% of 102 respondent firms introduced only service innovations and 32.4% of them introduced only good innovations. On the other side, approximately 6% of total participants introduced neither good nor service innovation.

Table 8.6 : Product innovation.

	Frequency	**Percent**
Only new or significantly improved goods	33	32,4
Only new or significantly improved services	21	20,6
Both new or significantly improved goods and services	42	41,2
None of them	6	5,9
Total	102	100,0

Table 8.7 shows developers of these product innovations. Approximately 89% of the firms develop their product innovations themselves. %22 of the respondents develop new or significantly improved products with other enterprises or institutions. Other enterprises include independent enterprises, other parts of the respondent's enterprise group such as subsidiaries and sister enterprises, and institutions include universities, research laboratories and non-profit organizations. Only, %6 of the participating firms develop product innovations by adapting or modifying goods or services originally developed by other enterprises or institutions and %3 of the respondents have other enterprises and institutions develop product innovations. It is clear that respondents prefer to develop new or significantly improved products themselves or with other enterprises or institutions.

Table 8.7 : Developers of product innovations.

Enterprise by itself	**Frequency**	**Percent**
Yes	91	89,2
No	11	10,8
Total	102	100,0
Enterprise together with other enterprises or institutions	**Frequency**	**Percent**
Yes	22	21,6
No	80	78,4
Total	102	100,0
Enterprise by adapting or modifying goods or services originally developed by other enterprises or institutions	**Frequency**	**Percent**
Yes	6	5,9
No	96	94,1
Total	102	100,0
Other enterprises or institutions	**Frequency**	**Percent**
Yes	3	2,9
No	99	97,1
Total	102	100,0

Degrees of product innovations are shown in the Table 8.8. If a company introduces an innovation onto its own market before competitors, that innovation is new to market of the company. Also, if a company introduces an innovation that is already available in its own market, the innovation is only new to company. During the three years 2012 to 2014, approximately 74% of the respondent companies made product innovations that are new to market and approximately 47% of the companies made product innovations that are only new to the firm. As it is understood, product innovations, which are new to market, are new for the firm as well.

Table 8.8 : Degree of product innovation.

New to your market	Frequency	Percent	New to the firm	Frequency	Percent
Yes	75	73,5	Yes	54	52,9
No	27	26,5	No	48	47,1
Total	102	100,0	Total	102	100,0

8.1.10.2 Process Innovation

It was already mentioned in the literature section that new or significantly improved production processes, distribution methods, and supporting activities are process innovations. During the three years 2012 to 2014, whether the company introduced a process innovation or not was questioned. Frequencies and percentages of the responses given from participants are shown in the Table 8.9. 56.9% of the respondent companies introduced only new or significantly improved methods of manufacturing or producing goods or services, 2% of them introduced only new or significantly improved supporting activities for their processes, such as maintenance systems or operations for purchasing, accounting or computing during last three years, and only 7.8% of all participants introduced only new or significantly improved logistics, delivery or distribution methods for their inputs, goods or services during the three years 2012 to 2014. Approximately %4 of participating companies introduced all of them. On the other side, 10.8% of participants introduced none of them.

Table 8.9 : Process innovation.

	Frequency	Percent
Only new or significantly improved methods of manufacturing or producing methods	58	56,9
Only new or significantly improved logistics, delivery or distribution methods	2	2,0
Only new or significantly improved supporting activities for your processes	8	7,8
Both manufacturing/ producing and logistic/delivery/distribution methods	2	2,0
Both manufacturing/producing methods and supporting activities	13	12,7
Both logistic/delivery/distribution methods and supporting activities	4	3,9
All of them	4	3,9
None of them	11	10,8
Total	102	100,0

Developers of mentioned process innovations of the companies are given in the Table 8.10. 84.3% of the companies develop their process innovations by themselves, 21% of them develop new or significantly improved production processes, distribution methods, and supporting activities together with other enterprises or institutions. Here, again, other enterprises are independent enterprises and other parts of the participating companies' enterprise group such as subsidiaries and sister enterprises. Institutions are universities, research institutions or non-profit organizations. Approximately 7% of the participating enterprises develop process innovations by adapting or modifying goods or services originally developed by other enterprises or institutions and 3% of all respondents have other enterprises or institutions develop process innovations. Responses given regarding developers of product innovations are similar to responses of this question. So, we can say again that respondents prefer to develop process innovations by themselves or together with other enterprises or institutions.

Table 8.10 : Developers of process innovation.

Enterprise by itself	**Frequency**	**Percent**
Yes	86	84,3
No	16	15,7
Total	102	100,0
Enterprise together with other enterprises or institutions	**Frequency**	**Percent**
Yes	21	20,6
No	81	79,4
Total	102	100,0
Enterprise by adapting or modifying processes originally developed by other enterprises or institutions	**Frequency**	**Percent**
Yes	7	6,9
No	95	93,1
Total	102	100,0
Other enterprises or institutions	**Frequency**	**Percent**
Yes	3	2,9
No	99	97,1
Total	102	100,0

Degree of process innovation was also questioned and responses given by the companies are shown in the Table 8.11. According to the responses, approximately 66% of the companies' introduced process innovations during the three years 2012 to 2014 new to their own market.

Table 8.11 : Degree of process innovation.

New to your market	**Frequency**	**Percent**
Yes	67	65,7
No	35	34,3
Total	102	100,0

8.1.11 Importance of collaborating partner

During the development of innovation, significance levels of the collaborating partners were also asked to respondents on 5-Likert Scale where 5 implies "very important" and 1 implies "unimportant". Table 8.12 shows significance levels of the collaborating partners. The range of responses' mean varies between 2.67 and 4.55. According to the responses given by participants, the most important collaborating partners during development of innovation are employees and the least important

collaborating partners are development agencies. Customers and support and incentive funds respectively follow employees.

Table 8.12 : Significance level of collaborating partner.

Collaborating Partners	N	Mean	Std. Deviation
Employees	102	4,55	1,030
Consultants	102	3,45	1,248
Support and Incentive Funds	102	3,79	1,245
Development Agencies	102	2,67	1,374
Customers	102	4,21	1,047
Competitor Companies	102	3,00	1,160
Suppliers/ Stakeholders	102	3,22	1,122
Technology Transfer Offices	102	2,92	1,377
Universities and Other Academic Institutions	102	3,18	1,338

8.1.12 Open innovation knowledge of the respondent

How respondents are knowledgeable about open innovation was also investigated on 5-Likert scale where 5 stands for “agree strongly” and 1 stands for “disagree strongly”. Mean of the responses is found as 3.74 and standard deviation is approximately 1 (see Table 8.13). This shows that respondents are almost knowledgeable about open innovation.

Table 8.13 : Open innovation knowledge of the respondent.

	N	Mean	Std. Deviation
I am knowledgeable about open innovation	102	3,74	1,004

8.1.13 Open innovation knowledge of the organization

How organization is knowledgeable about open innovation was investigated on 5-Likert scale as well. Table 8.14 shows the mean and standard deviation of responses. Mean is found as 3.21 and standard deviation is approximately 1.06. Participating companies are almost knowledgeable about open innovation.

Table 8.14 : Open innovation knowledge of the organization.

	N	Mean	Std. Deviation
Organization is knowledgeable about open innovation	102	3,21	1,056

8.1.14 Open innovation practices

A question related open innovation was asked to participants to understand the status of the firms if they are practicing open innovation. 5-Likert scale was used and 5 implies “we use already, 4 “we are about to use/planning to use”, 3 “implementation would be good”, 2 “we do not consider to use”, 1 “we never use”. The range of responses’ mean varies between 3.20 and 4.34. Customer immersion, collaboration, and lead users are the most preferred open innovation practices respectively. Additionally, customer immersion got the lowest standard deviation as well which signifies that respondents agree upon this practice. On the other hand, idea competition is the least preferred open innovation practice by respondents and has the highest standard deviation with approximately 1.17 (see Table 8.15).

Table 8.15 : Open innovation practices.

Open Innovation Practices	N	Mean	Std. Deviation
Idea competitions/Challenges	102	3,20	1,169
IP or tech-out licensing or selling	102	3,53	,972
IP or Tech-in licensing or acquisition	102	3,50	1,150
Innovation Network	102	3,53	,951
Innovation Intermediaries	102	3,34	1,029
Collaboration	102	4,12	1,008
Customer Immersion	102	4,34	,884
Lead Users	102	4,10	1,067
Platforming	102	3,79	1,084

8.1.15 Duration of practicing open innovation

For how many years respondent company has been practicing open innovation was asked to participants. Because of the fact that 5 of 102 respondent companies do not use any open innovation practices, they did not select any option of this question. Table 8.16 shows the frequencies and percentages regarding duration of practicing

open innovation. 37.3% of all companies have been practicing open innovation for less than 1 year. On the other side, approximately 5% of all respondents have been practicing open innovation for more than 10 years.

Table 8.16 : Duration of practicing open innovation.

	Frequency	Percent
We do not use	5	4,9
Less than 1 year	38	37,3
1-3 years	32	31,4
3-5 years	16	15,7
5-10 years	6	5,9
More than 10 years	5	4,9
Total	102	100

8.1.16 Intensity of open innovation implementation

The statement "compared to three years ago, our organization is implementing open innovation more intensely" on a 5-Likert scale where 5 stands for total agreement and 1 stands for total disagreement were given to respondents. Table 8.17 shows the mean and standard deviation of responses given by participants. Mean of the responses is 3.81 and standard deviation is approximately 1.06.

Table 8.17 : The intensity of open innovation implementation.

	N	Mean	Std. Deviation
Implementing OI more intensely	97	3,81	1,064

8.1.17 Motives to open innovation

Significance level of each motive to open innovation was asked to participants on 5-Likert scale where 5 implies "very important" and 1 implies "unimportant". Table 8.18 shows mean and standard deviation of each statement. The range of responses' mean varies between 3.45 and 4.30. Exploring new technological trends, accelerating time to complete R&D, and identifying new business opportunities are the highest scored statements respectively. On the other hand, establishing new partnerships is the lowest scored statement by participants and this statement has the highest standard deviation with approximately 1.3.

Table 8.18 : The firms' motives to open innovation.

	N	Mean	Std. Deviation
Accelerating time to complete R&D	97	4,28	1,058
Minimizing risk of innovation projects	97	3,77	,974
Reducing R&D costs per project	97	3,96	1,010
Exploring new technological trends	97	4,30	,970
Identifying new business opportunities	97	4,23	1,046
Establishing new partnerships	97	3,45	1,299

8.1.18 Investment on open innovation

In the last three years, how much of all the investment company made in innovative products if these products fall under open innovation category was asked to respondents. Frequencies and percentages of responses are shown in the Table 8.19. Responses show that most of the firms with 32.4% have invested more than 20% of all investments in innovative products, which fall under open innovation category. However, approximately 18% of all participating firms haven't made investment for innovative products that fall under open innovation category in the last three years. Also, again approximately 18% of all respondent firms have made investment between 6% to 10%. Only 6.9% of 102 respondents have invested between 16% to 20% in innovative products.

Table 8.19 : The investments made for open innovation.

	Frequency	Percent
No investment	18	17,6
1%-5%	17	16,7
6%-10%	18	17,6
11%-15%	9	8,8
16%-20%	7	6,9
More than 20%	33	32,4
Total	102	100,0

8.1.19 Sales revenue from open innovation

After asking percentages of investments, percentage of sales revenues from innovative products that fall under open innovation category was asked to respondents. 26.5% of all firms could not get sales revenue from innovative products in the last three years. On the other hand, 23.5% of all firms got more than 20% of their all sales revenue from innovative products, which fall under open innovation category in the last three years (see Table 8.20).

Table 8.20 : The firms' sales revenue from open innovation.

	Frequency	Percent
No revenue	27	26,5
1%-5%	17	16,7
6%-10%	15	14,7
11%-15%	11	10,8
16%-20%	8	7,8
More than 20%	24	23,5
Total	102	100,0

8.1.20 Management support to open innovation

The statement "compared to three years ago, management support to open innovation has increased" on a 5-Likert scale where 5 stands for total agreement and 1 stands for total disagreement were given to respondents. Mean and standard deviation of the responses are given in the Table 8.21. Mean and standard deviation are found as 3.72 and 1.07 respectively.

Table 8.21 : The management support to open innovation.

	N	Mean	Std. Deviation
Management Support to OI	97	3,72	1,068

8.1.21 Actions to compensate barriers on competition

In the last question, selecting the significance level of actions that companies can take if they encounter a more challenging competitive environment and lower profit margin was requested from respondents on 5-Likert scale where 5 implies very important and 1 implies unimportant. The range of actions' means varies between 2.19 and 4.19. Table 8.22 shows mean and standard deviation of each action. According to the responses, improving quality of products is the most important action. It is followed by improving marketing activities and forming strategic partnerships with 4.03 and 4.00 mean respectively. On the other hand, reducing production is the least important action.

Table 8.22 : The actions to compensate barriers on competition.

	N	Mean	Std. Deviation
Increasing working hours	102	2,53	1,216
Increasing product differentiation	102	3,66	1,112
Looking for different markets	102	3,80	1,135
Reducing prices of goods/services	102	2,96	1,143
Improving quality of goods/services	102	4,19	,887
Looking for market niches	102	3,98	1,117
Improving marketing activities	102	4,03	,928
Forming strategic partnerships	102	4,00	1,005
Reducing production	102	2,19	1,097
Reducing production costs	102	3,80	1,135

8.2 Internal Consistency Reliability and Exploratory Factor Analysis

Because of the fact that our survey includes too many subjective responses, performing reliability analysis has a great importance. Internal consistency reliability of the survey has been investigated by using Cronbach's alpha approach that is used when the scales are Likert type. The general reliability of the survey for all scaled questions is 0.859 while using Cronbach's alpha model. Cronbach's alpha reliability coefficient of the scale in case of deleting an item from the scale has been investigated for all items and none of them has been deleted because of the fact that they do not change the result when they are extracted.

After performing reliability analysis, exploratory factor analysis has been performed to determine construct validity of the scale. Factor analysis has been made for the scales regarding constraints on open innovation. All items of four questions related to general constraints on open innovation, constraints on inbound open innovation, constraints on outbound open innovation and human resources constraints on open innovation have been subjected to factor analysis. Cronbach's alpha internal consistency coefficients of the scales that will be subjected to exploratory factor analysis are calculated before performing factor analysis. Table 8.23 shows Cronbach's alpha coefficients of each scaled question regarding constraints on open innovation.

Table 8.23 : Cronbach's alpha coefficient before factor analysis.

	N	Cronbach's Alpha
General Constraints on Open Innovation	13	0,869
Constraints on Inbound Open Innovation	4	0,720
Constraints on Outbound Open Innovation	4	0,828
Human Resources Constraints on Open Innovation	7	0,858

Principal component analysis that is most used approach among all factoring techniques has been preferred as factoring technique of factor analysis. Additionally, orthogonal rotation has been preferred due to the fact that it is easy to interpret and provide almost the same results with oblique rotation and varimax technique has been used to perform orthogonal rotation.

Before determining the construct validity of the scale, whether it is appropriate for factor analysis or not has been measured by Kaiser-Meyer-Olkin Measure of Sampling Adequacy and whether correlation matrix is equal to unit matrix or not has been measured by Barlett's Test of Sphericity. High KMO value indicates that each of the variables can be predicted by other variables in the scale. Table 8.24 shows the results of KMO and Bartlett's Test. KMO value of the scale is 0.863. In this case, this value is meritorious and enough to continue with factor analysis. Additionally, value of Barlett's Test of Sphericity is meaningful. Because, null hypothesis (All correlation coefficients are not quite far from zero) is rejected on a level of statistical significance $p<0.0005$ for 1145,629 Approx. Chi-Square. When both results are taken into account, exploratory factor analysis can be performed. Moreover, anti-image correlation matrix has been investigated before performing factor analysis and it was seen that all diagonal values that are used as a measure of sampling adequacy were greater than 0.50.

Table 8.24 : Results of KMO and Bartlett's Test.

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		,863
Bartlett's Test of Sphericity	Approx. Chi-Square	1145,629
	Df	276
	Sig.	,000

Scree plot and variance explained by factors have been investigated in order to decide the numbers of factors, and it was decided to scale has 6 factors. Also, principle component analysis with varimax rotation technique has been applied to decide which items of the scale will remain in the scale. Principal components analysis has been released 6 components that jointly attribute to the 67.629% of total variance.

According to Tabachnick and Fidell (2001), factor loading of each item should be higher than 0.32 as a basic guide. In addition, according to Büyüköztürk (2002), factor loading between 0.30 and 0.59 is considered as moderately high and factor loading higher than 0.60 is considered as high. Furthermore, difference between two factor loadings should be more than 0.10 if factor loading of an item has high values in two factors (Tabachnick and Fidell, 2001). Finally, communalities for each item have a value over 0.5 that is an indicator of satisfactory quality of the measurements. Considering these all criteria, factors have been determined. Because of the fact that factor loadings of "intellectual property rights", "user acceptance", "lack of marketplaces for technologies", and "too much and resource requirements" are high in more than one factor and difference between them are less than 0.10, these three items has been removed from factor analysis and analysis has been performed one more time. Table 8.25 shows the components and factor loadings that were produced after performing principal component analysis.

More specifically, based on constraints on open innovation as presented by the factor analysis, items "not sold here syndrome", "complexity of the intellectual property rights, fear of infringements", "fear of losing own innovation ability", "not invented here syndrome", "the difficulty of finding buyers", and "employees are reluctant to share information" particularly with high loadings (0.757, 0.733, 0.703, 0.687, 0.609, 0.577) load on the first factor F1, with eigenvalue 8.624, which explains 35.932% of total dispersion. Factor 1 represents confidentiality and conservativeness. Five of eight items of the questions related to constraints on inbound and open innovation that were taken from the study of Savitskaya and others (2010) are in factor 1. Additionally, remained one item "employees are reluctant to share information" was added to question regarding human resources constraints on open innovation by expert from ITUNOVA TTO.

Table 8.25 : Components and factor loadings.

FACTORS	Factor Loading	Communality
F1: Confidentiality, Conservativeness		
Not sold here syndrome	0,757	0,732
The complexity of the intellectual property rights, fear of infringements	0,733	0,654
Fear of losing own innovation ability	0,703	0,660
Not invented here syndrome	0,687	0,712
The difficulty of finding buyers	0,609	0,762
Employees are reluctant to share information	0,577	0,686
F2: Human Resources, Brand and Image		
Unpleasant works	0,813	0,743
Unpleasant working conditions	0,758	0,695
Lack of skilled manpower	0,704	0,720
The high staff turnover	0,604	0,639
The low image of the firm	0,566	0,637
F3: Resources and Costs		
Marketing	0,681	0,669
High wage levels	0,665	0,585
Resources	0,589	0,682
Competent employees	0,581	0,683
F4: Management and Organization		
Commitment	0,707	0,631
Organization/ culture	0,706	0,621
Idea Management	0,664	0,586
Knowledge	0,555	0,704
F5: Market, Partnership, Technology Sources		
Customer demand	0,763	0,717
Partners	0,706	0,618
No adequate technologies on offer	0,665	0,609
F6: Administrative Constraints		
Administration	0,794	0,714
Finance	0,756	0,769

Items “unpleasant works”, “unpleasant working conditions”, “lack of skilled manpower”, “high staff turnover”, and “low image of the firm” particularly with high loadings (0.813, 0.758, 0.704, 0.604, 0.566) load on the second factor F2, with eigenvalue 1.947, which explains 8.113% of total dispersion. Factor 2 consists of the statements regarding human resources, brand and image. While taking opinions of the expert to determine face validity of the survey, “low image of the sector” and “low image of the type of enterprise” items of the question concerning human resource constraints on open innovation that was taken from the study of Rahman and Ramos (2013) has been removed from the question and “low image of the firm”

has been added because of the fact that this study is firm-focused. It is clear that this new item is again in the factor named as human resources, brand and image. Also other four statements of factor 2 are from the same question that was taken from the study of Rahman and Ramos (2013).

Items “marketing”, “high wage levels”, “resources”, and “competent employees” particularly with high loadings (0.681, 0.665, 0.589, 0.581) load on the third factor F3, with eigenvalue 1.657, which explains 6.905% of total dispersion. Factor 3 has been named as resources and costs. Although marketing seems irrelevant to resources and costs, description that was taken from the study of Krause and others (2012) and given for this statement in the survey is “insufficient market intelligence, market affinity, marketing problems with new products”. Thus, intelligence can be considered as a resource. Statement “high wage levels” is from the question concerning human resources constraints on open innovation that was taken from the study of Rahman and Ramos (2013) and other three statements are from the question regarding general constraints on open innovation that was taken from the study of Krause and others (2012). Given explanations of these three items are closely connected with resources and cost.

Items “commitment”, “organization/culture”, “idea management”, and “knowledge” particularly with high loadings (0.707, 0.706, 0.664, 0.555) load on the fourth factor F4, with eigenvalue 1.505, which explains 6.272% of total dispersion. Factor 4 consists of statements regarding management and organization. All items are from the question concerning general constraints on open innovation.

Items “customer demand”, “partners”, and “no adequate technologies on offer” particularly with high loadings (0.763, 0.706, 0.665) load on the fifth factor F5, with eigenvalue 1.334, which explains 5.560% of total dispersion. Factor 5 has been denominated as market, partnership and technology resources. Statement “no adequate technologies on offer” is from the question regarding constraints on inbound open innovation that was taken from the study of Savitskaya and others (2010) and other statements are from the study of Krause and others (2012).

The sixth and last factor F6 with eigenvalue 1.163 and high loadings (0.794, 0.756) which explains 4.846% of total dispersion, has been constructed and interpreted by

statements “administration” and “finance”. Factor 6 has been denominated as administrative because of the fact that statements are closely associated with it.

After performing factor analysis, reliability of each factor has been investigated. Table 8.26 shows Cronbach’s alpha internal consistency coefficients of the factors.

Table 8.26 : Cronbach's alpha coefficients after factor analysis.

Factors	N	Cronbach’s Alpha
Confidentiality, conservativeness	6	0,872
Human resources, brand and image	5	0,836
Resources and costs	4	0,775
Management and organization	4	0,756
Market, partnership and technology sources	3	0,702
Administrative constraints	2	0,694

Table 8.27 shows descriptive statistics regarding factors. The range of factors’ mean varies between 2.47 and 3.14. Here, 5 implies “never” and 1 implies “very frequently”. Administrative constraints, constraints regarding resources and costs, and constraints regarding management and organization are the most frequently encountered constraints by SMEs. On the other hand, constraints regarding human resource, brand and image are the least frequently encountered constraints by SMEs.

Table 8.27 : Factors.

Factors	N	Mean	Std. Deviation
Confidentiality, conservativeness	97	3,01	,909
Human resources, brand and image	97	3,14	,931
Resources and costs	97	2,55	,922
Management and organization	97	2,95	,887
Market, partnership and technology sources	97	3,02	,923
Administrative	97	2,47	1,093

8.3 Correlations between Factors

Correlation is a statistical technique, which describes degree of relationship and whether relationship is negative or positive between two or more variables.

Correlation is measured by correlation coefficient that ranges from -1.00 to +1.00. The sign of the correlation coefficient define direction of the relationship between variables. In a positive relationship, correlation coefficient has a plus sign, whereas correlation coefficient has a minus sign in negative relationships. In a positive relationship, when one variable increases, the other variable also increases and if one variable decreases, the other one tends to also decrease. However, variables tend to move in opposite direction in a negative relationship.

Also, degree of relationship is measured by correlation coefficient. When two variables are perfectly related, correlation coefficient is either -1.00 (perfect negative correlation) or +1.00 (perfect positive correlation). Closer the correlation coefficient is to -1.00 or +1.00; greater is the degree of the relationship between two variables. On the other hand, correlation coefficient is 0.00 when two variables have no relationship at all.

Table 8.28 shows an interpretation guideline on strength of relationship as a rule of thumb (Mukaka, 2012).

Table 8.28 : Interpretation guideline on strength of relationship (Mukaka, 2012).

Value of correlation coefficient (r)	Strength/Degree of relationship
.90 to 1.00 (-.90 to -1.00)	Very high positive (negative) correlation
.70 to .90 (-.70 to -.90)	High positive (negative) correlation
.50 to .70 (-.50 to -.70)	Moderate positive (negative) correlation
.30 to .50 (-.30 to -.50)	Low positive (negative) correlation
.00 to .30 (-.00 to -.30)	Negligible correlation

The arithmetic mean of statements in each factor has been calculated and correlation analysis has been performed so as to determine strength and direction of the linear relationships between pairs of factors. Pearson product correlation coefficient has been preferred because factors are normally distributed.

As it is shown in the Table 8.29, the correlation coefficient for confidentiality, conservativeness and human resources, brand and image is 0.583. Hence, there is a moderate positive relationship between these two factors. The correlation coefficient is 0.560 for confidentiality, conservativeness and resources and costs. In this case, confidentiality, conservativeness is positively and moderately correlated with resources and costs. There is again a moderate positive relationship between

confidentiality, conservativeness and management and organization because of the fact that Pearson correlation coefficient is 0.529 for them. Correlation coefficient for confidentiality, conservativeness and market, partnership and technology resources is 0.448. This shows that there is a low positive correlation between these two factors. There is also a low positive correlation between confidentiality, conservativeness and administrative statements. Pearson correlation coefficient for them is 0.397. In addition, correlation between human resources, brand and image and resources and costs is 0.534. It means that there is a moderate positive correlation between these factors. Correlation coefficient between human resources, brand and image and management and organization is 0.455. Therefore, there is a low positive correlation between them. The relationship between human resources, brand and image and market, partnership, and technology sources is weakly positive and correlation coefficient for them is 0.443. Correlation between human resources, brand and image and administrative statements is negligible due to the fact that Pearson correlation coefficient is 0.253 and correlation is significant at the 0.01 level unlike other all correlations that are significant at the 0.05 level. On the other side, there is a moderate positive correlation between resources and costs and management and organization with 0.573. Correlation coefficient between resources and costs and market, partnership, and technology sources is 0.489 and correlation is weakly positive. Also, correlation between resources and costs and administrative statements is weakly positive owing to the fact that value of Pearson correlation coefficient between these factors is 0.451. Correlation between management and organization and market, partnership, technology sources and correlation between management and organization and administrative statements are low and positive with 0.410 and 0.425 correlation coefficients respectively. Finally, there is a negligible correlation between market, partnership, and technology sources and administrative statements owing to the fact that correlation coefficient for these two factors is 0.274.

Table 8.29 : Correlations between factors.

Correlations						
		F1	**F2**	**F3**	**F4**	**F5**	**F6**
F1	Pearson Correlation	1	,583**	,560**	,529**	,448**	,397**
	Sig. (2-tailed)		,000	,000	,000	,000	,000
	N	97	97	97	97	97	97
F2	Pearson Correlation	,583**	1	,534**	,455**	,443**	,253*
	Sig. (2-tailed)	,000		,000	,000	,000	,012
	N	97	97	97	97	97	97
F3	Pearson Correlation	,560**	,534**	1	,573**	,489**	,451**
	Sig. (2-tailed)	,000	,000		,000	,000	,000
	N	97	97	97	97	97	97
F4	Pearson Correlation	,529**	,455**	,573**	1	,410**	,425**
	Sig. (2-tailed)	,000	,000	,000		,000	,000
	N	97	97	97	97	97	97
F5	Pearson Correlation	,448**	,443**	,489**	,410**	1	,274**
	Sig. (2-tailed)	,000	,000	,000	,000		,007
	N	97	97	97	97	97	97
F6	Pearson Correlation	,397**	,253*	,451**	,425**	,274**	1
	Sig. (2-tailed)	,000	,012	,000	,000	,007	
	N	97	97	97	97	97	97

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

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

8.4 Hypothesis Test

8.4.1 Difference tests

Tests chosen to analyze the data should be based on the type of data collected and some other key properties of the data. Data analysis methods are divided into two main groups depending on the characteristics of the data as parametric and nonparametric tests. Parametric tests are more robust than nonparametric tests. To use parametric tests, three parameters should be true or are assumed. Firstly, the data need to be normally distributed and need to have equal variance and the same standard deviation. In addition, the data need to be continuous. The most commonly used parametric tests are Pearson Product Correlation Coefficient, Student t-Test, z-Test, and ANOVA (Analysis of Variance). On the other hand, the data should be analyzed with a nonparametric test if the data do not meet the criteria given for a parametric test and the most commonly used nonparametric tests are Chi-squared, Spearman Rank Coefficient, Mann-Whitney U Test, and Kruskal-Wallis Test (Neideen and Brasel, 2007).

Normality tests have been performed on the data to choose the appropriate test method for each analysis. If the data is normally distributed, t-Test and ANOVA have been used. In the contrary case, Mann-Whitney U Test and Kruskal-Wallis Test have been used.

8.4.1.1 Age of the company

H_{111}: There is a statistically significant difference in rewarding individuals, groups or companies to provide ideas in the form of a competition or challenge with respect to age of the company.

H_{112}: There is a statistically significant difference in licensing or selling company's own patents and technology to other organizations with respect to age of the company.

H_{113}: There is a statistically significant difference in licensing or buying patents and technology with respect to age of the company.

H_{114}: There is a statistically significant difference in being part of an innovation network with respect to age of the company.

H_{115}: There is a statistically significant difference in getting help from an innovation intermediary with respect to age of the company.

H_{116}: There is a statistically significant difference in developing new products through collaborating with customers, suppliers, or other 3^{rd} party partners with respect to age of the company.

H_{117}: There is a statistically significant difference in observing customer-product interaction process to enhance good or services with respect to age of the company.

H_{118}: There is a statistically significant difference in identifying innovations added to company's own product by users and then incorporating these ideas back into products with respect to age of the company.

H_{119}: There is a statistically significant difference in providing a platform, which customers can extend the capabilities of the products, with respect to age of the company.

To test hypotheses, Mann Whitney U Test has been performed because of the fact that variables are not normally distributed and there are two groups of establishment

year (before 2010, after 2010). Table 8.30 shows statistics of Mann-Whitney U Test for all hypotheses regarding open innovation practices and age of the company.

Table 8.30 : Mann-Whitney U test results for open innovation practices and age of the company.

	Establishment Year	N	Mean Rank	Sum of Ranks	U	p
Idea competition/challenges	Before 2010	53	51,87	2749,00	1279,000	,891
	After 2010	49	51,10	2504,00		
	Total	102				
IP or tech-out licensing or selling	Before 2010	53	52,28	2771,00	1257,000	,771
	After 2010	49	50,65	2482,00		
	Total	102				
IP or tech-in licensing or acquisition	Before 2010	53	50,44	2673,50	1242,500	,697
	After 2010	49	52,64	2579,50		
	Total	102				
Innovation network	Before 2010	53	47,08	2495,00	1064,000	,090
	After 2010	49	56,29	2758,00		
	Total	102				
Innovation intermediaries	Before 2010	53	46,93	2487,50	1056,500	,083
	After 2010	49	56,44	2765,50		
	Total	102				
Collaboration	Before 2010	53	52,07	2759,50	1268,500	,829
	After 2010	49	50,89	2493,50		
	Total	102				
Customer immersion	Before 2010	53	55,13	2922,00	1106,000	,149
	After 2010	49	47,57	2331,00		
	Total	102				
Lead users	Before 2010	53	53,33	2826,50	1201,500	,480
	After 2010	49	49,52	2426,50		
	Total	102				
Platforming	Before 2010	53	52,81	2799,00	1229,000	,626
	After 2010	49	50,08	2454,00		
	Total	102				

Hypotheses H_{111}, H_{112}, H_{113}, $H_{114,}$ H_{115}, H_{116}, H_{117}, H_{118}, and H_{119} have been rejected because of the fact that there is not a statistically significant difference in these open innovation approaches depending on age of the company ($p>0.05$). It can be said that, firm age does not affect the use of open innovation practices.

H_{121}: There is a statistically significant difference in importance level of accelerating time to complete R&D as a motivation factor during the use of open innovation with respect to age of the company.

H_{122}: There is a statistically significant difference in importance level of minimizing risk of innovation projects as a motivation factor during the use of open innovation with respect to age of the company.

H_{123}: There is a statistically significant difference in importance level of reducing R&D costs per project as a motivation factor during the use of open innovation with respect to age of the company.

H_{124}: There is a statistically significant difference in importance level of exploring new technological trends as a motivation factor during the use of open innovation with respect to age of the company.

H_{125}: There is a statistically significant difference in importance level of identifying new business opportunities as a motivation factor during the use of open innovation with respect to age of the company.

H_{126}: There is a statistically significant difference in importance level of establishing new partnerships as a motivation factor during the use of open innovation with respect to age of the company.

To test hypotheses, Mann-Whitney U Test has been performed because of the fact that variables are not normally distributed and there are two groups of establishment year (before 2010, after 2010). Table 8.31 shows statistics of Mann-Whitney U Test for all hypotheses regarding motives to practice open innovation and age of the company.

Hypotheses H_{121}, H_{122}, H_{123}, and H_{126} have been rejected ($p>0.5$). In this case, importance levels of these motivation factors (accelerating time to complete R&D, minimizing risk of innovation projects, reducing R&D costs per project, and establishing new partnerships) during the use of open innovation are not affected by age of the company. On the other hand, H_{124} and H_{125} have been accepted ($p<0.5$). There is a statistically significant difference in importance level of exploring new technological trends as a motivation factor during the use of open innovation with respect to age of the company. This difference militates in favor of companies founded before 2010 (mean rank=55.34). Moreover, there is a statistically significant difference in importance level of identifying new business opportunities as a motive to open open innovation with respect to age of the company. This significant difference militates in favor of companies founded before 2010 (mean rank=54.91).

Table 8.31 : Mann-Whitney U test results for motives to open innovation and age of the company.

	Establishment Year	N	Mean Rank	Sum of Ranks	U	P
Accelerating time to complete R&D	Before 2010	50	55,34	2767,00	956,000	,078
	After 2010	47	42,26	1986,00		
	Total	97				
Minimizing risk of innovation projects	Before 2010	50	53,38	2669,00	1071,500	,430
	After 2010	47	44,34	2084,00		
	Total	97				
Reducing R&D costs per project	Before 2010	50	46,93	2346,50	969,000	,114
	After 2010	47	51,20	2406,50		
	Total	97				
Exploring new technological trends	Before 2010	50	44,88	2244,00	858,000	,011
	After 2010	47	53,38	2509,00		
	Total	97				
Identifying new business opportunities	Before 2010	50	54,91	2745,50	879,500	,019
	After 2010	47	42,71	2007,50		
	Total	97				
Establishing new partnerships	Before 2010	50	48,96	2448,00	1173,000	,988
	After 2010	47	49,04	2305,00		
	Total	97				

H_{131}: There is a statistically significant difference in frequencies of encountering constraints regarding confidentiality and conservativeness during the use of open innovation with respect to age of the company.

H_{132}: There is a statistically significant difference in frequencies of encountering constraints regarding human resources, brand and image during the use of open innovation with respect to age of the company.

H_{133}: There is a statistically significant difference in frequencies of encountering constraints regarding resources and costs during the use of open innovation with respect to age of the company.

H_{134}: There is a statistically significant difference in frequencies of encountering constraints regarding management and organization during the use of open innovation with respect to age of the company.

H_{135}: There is a statistically significant difference in frequencies of encountering constraints regarding market, partnership and technology sources during the use of open innovation with respect to age of the company.

H_{136}: There is a statistically significant difference in frequencies of encountering administrative constraints during the use of open innovation with respect to age of the company.

To test hypotheses, t-Test has been performed because of the fact that variables are normally distributed and there are two groups of establishment year (before 2010, after 2010). Table 8.32 shows statistics of t-Test for all hypotheses regarding constraints on open innovation and age of the company.

According to t-Test results it can be said that there is not a statistically significant difference in any frequencies of encountering constraints on open innovation with respect to age of the company. All hypotheses H_{131}, H_{132}, H_{133}, H_{134}, H_{135}, and H_{136} have been rejected ($p>0.05$). In the circumstances, frequency of encountering constraints on open innovation is not affected by age of the company.

Studies on this subject are very diverse. Keupp and Gasmann (2009) argue that age is not a predictor for practicing open innovation. However, Idrissia and others (2012) suggest that the older the company, the higher the probability of using open innovation.

Table 8.32 : t-Test results for constraints on open innovation and age of the company.

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Confidentiality, conservativeness	Equal variances assumed	,102	,750	-,993	95	,323	-,183475177	,184695000	-,550141112	,183190758
	Equal variances not assumed			-,993	94,364	,323	-,183475177	,184807992	-,550397317	,183446962
Human resources, brand and image	Equal variances assumed	3,242	,075	-,655	95	,514	-,12426	,18972	-,50089	,25238
	Equal variances not assumed			-,658	94,072	,512	-,12426	,18876	-,49905	,25054
Resources and costs	Equal variances assumed	,037	,847	-,730	95	,467	-,13702	,18770	-,50965	,23561
	Equal variances not assumed			-,729	94,193	,468	-,13702	,18788	-,51004	,23600
Management and organization	Equal variances assumed	3,677	,058	-,640	95	,524	-,11564	,18068	-,47432	,24305
	Equal variances not assumed			-,634	84,120	,528	-,11564	,18238	-,47831	,24703
Market, partnership and technology sources	Equal variances assumed	,359	,550	-,372	95	,711	-,070070922	,188313742	-,443920967	,303779123
	Equal variances not assumed			-,372	94,864	,710	-,070070922	,188168639	-,443639811	,303497967
Administrative	Equal variances assumed	,038	,845	-,132	95	,896	-,029361702	,223205538	-,472480721	,413757317
	Equal variances not assumed			-,132	94,906	,896	-,029361702	,222988981	-,472056452	,413333048

H_{141}: There is a statistically significant difference in importance level of increasing the working hours as an action to compensate the constraints with respect to age of the company.

H_{142}: There is a statistically significant difference in importance level of increasing product differentiation as an action to compensate the constraints with respect to age of the company.

H_{143}: There is a statistically significant difference in importance level of looking for different markets as an action to compensate the constraints with respect to age of the company.

H_{144}: There is a statistically significant difference in importance level of reducing prices of products as an action to compensate the constraints with respect to age of the company.

H_{145}: There is a statistically significant difference in importance level of improving quality of products as an action to compensate the constraints with respect to age of the company.

H_{146}: There is a statistically significant difference in importance level of looking for market niches as an action to compensate the constraints with respect to age of the company.

H_{147}: There is a statistically significant difference in importance level of improving marketing activities as an action to compensate the constraints with respect to age of the company.

H_{148}: There is a statistically significant difference in importance level of forming strategic partnerships as an action to compensate the constraints with respect to age of the company.

H_{149}: There is a statistically significant difference in importance level of reducing production as an action to compensate the constraints with respect to age of the company.

H_{1410}: There is a statistically significant difference in importance level of reducing production costs as an action to compensate the constraints with respect to age of the company.

To test hypotheses, Mann-Whitney U Test has been performed because of the fact that variables are not normally distributed and there are two groups of establishment year (before 2010, after 2010). Table 8.33 shows statistics of Mann-Whitney U Test for all hypotheses regarding actions to compensate barriers on competition and age of the company.

Table 8.33 : Mann-Whitney U test results for actions to compensate barriers on competition and age of the company.

	Establishment Year	N	Mean Rank	Sum of Ranks	U	p
Increasing the working hours	Before 2010	53	52,26	2770,00	1258,000	,780
	After 2010	49	50,67	2483,00		
	Total	102				
Increasing product differentiation	Before 2010	53	51,76	2743,50	1284,500	,922
	After 2010	49	51,21	2509,50		
	Total	102				
Looking for different markets	Before 2010	53	58,94	3124,00	904,000	,006
	After 2010	49	43,45	2129,00		
	Total	102				
Reducing prices of goods/services	Before 2010	53	47,92	2539,50	1108,500	,188
	After 2010	49	55,38	2713,50		
	Total	102				
Improving quality of goods/services	Before 2010	53	56,34	2986,00	1042,000	,064
	After 2010	49	46,27	2267,00		
	Total	102				
Looking for market niches	Before 2010	53	54,93	2911,50	1116,500	,196
	After 2010	49	47,79	2341,50		
	Total	102				
Improving marketing activities	Before 2010	53	49,84	2641,50	1210,500	,531
	After 2010	49	53,30	2611,50		
	Total	102				
Forming strategic partnerships	Before 2010	53	49,32	2614,00	1183,000	,410
	After 2010	49	53,86	2639,00		
	Total	102				
Reducing production	Before 2010	53	46,14	2445,50	1014,500	,046
	After 2010	49	57,30	2807,50		
	Total	102				
Reducing production costs	Before 2010	53	47,92	2539,50	1108,500	,183
	After 2010	49	55,38	2713,50		
	Total	102				

Mann-Whitney U Test results show that hypotheses H_{141}, H_{142}, H_{144}, H_{145}, $H_{146,}$ H_{147}, H_{148}, and H_{1410} have been rejected ($p>0.05$). On the other hand, H_{143} and H_{149} have been accepted ($p<0.05$). Hence, there is statistically significant difference in importance level of looking for different markets as an action to compensate the constraints with respect to age of the company and difference militates in favor of companies founded before 2010 (mean rank=58.94). Also, there is statistically significant difference in importance level of reducing production as an action to

compensate the barriers on competition with respect to age of the company and this difference militates in favor of companies founded after 2010 (mean rank=57.30).

H_{151}: There is a statistically significant difference in importance level of employees as a collaborating partner during the development of innovation with respect to age of the company.

H_{152}: There is a statistically significant difference in importance level of consultants as a collaborating partner during the development of innovation with respect to age of the company.

H_{153}: There is a statistically significant difference in importance level of support and incentive funds as a collaborating partner during the development of innovation with respect to age of the company.

H_{154}: There is a statistically significant difference in importance level of development agencies as a collaborating partner during the development of innovation with respect to age of the company.

H_{155}: There is a statistically significant difference in importance level of customers as a collaborating partner during the development of innovation with respect to age of the company.

H_{156}: There is a statistically significant difference in importance level of competitor companies as a collaborating partner during the development of innovation with respect to age of the company.

H_{157}: There is a statistically significant difference in importance level of suppliers and stakeholders as a collaborating partner during the development of innovation with respect to age of the company.

H_{158}: There is a statistically significant difference in importance level of technology transfer offices as a collaborating partner during the development of innovation with respect to age of the company.

H_{159}: There is a statistically significant difference in importance level of universities and other academic institutions as a collaborating partner during the development of innovation with respect to age of the company.

To test hypotheses, Mann-Whitney U Test has been performed because of the fact that variables are not normally distributed and there are two groups of establishment

year (before 2010, after 2010). Table 8.34 shows statistics of Mann-Whitney U Test for all hypotheses regarding collaborating partners and age of the company.

Table 8.34 : Mann-Whitney U test results for collaborating partners and age of the company.

	Establishment Year	N	Mean Rank	Sum of Ranks	U	p
Employees	Before 2010	53	52,11	2762,00	1266,000	,766
	After 2010	49	50,84	2491,00		
	Total	102				
Consultants	Before 2010	53	48,81	2587,00	1156,000	,322
	After 2010	49	54,41	2666,00		
	Total	102				
Support and Incentive Funds	Before 2010	53	47,56	2520,50	1089,500	,144
	After 2010	49	55,77	2732,50		
	Total	102				
Development Agencies	Before 2010	53	49,85	2642,00	1211,000	,548
	After 2010	49	53,29	2611,00		
	Total	102				
Customers	Before 2010	53	56,76	3008,50	1019,500	,040
	After 2010	49	45,81	2244,50		
	Total	102				
Competitor Companies	Before 2010	53	52,59	2787,50	1240,500	,688
	After 2010	49	50,32	2465,50		
	Total	102				
Suppliers/ Stakeholders	Before 2010	53	51,67	2738,50	1289,500	,950
	After 2010	49	51,32	2514,50		
	Total	102				
Technology Transfer Offices	Before 2010	53	49,79	2639,00	1208,000	,535
	After 2010	49	53,35	2614,00		
	Total	102				
Universities and Other Academic Institutions	Before 2010	53	53,02	2810,00	1218,000	,581
	After 2010	49	49,86	2443,00		
	Total	102				

According to test results, H_{151}, H_{152}, H_{153}, H_{154}, H_{156}, H_{157}, H_{158}, H_{159} have been rejected ($p>0.05$). In that case, there is not a statistically significant difference in importance levels of related collaborating partners during the use of open innovation with respect to age of the company. On the other hand H_{155} has been accepted. There is a statistically significant difference in importance level of customers as a collaborating partner depending on age of the company ($p<0.05$). This difference militates in favor of companies founded before 2010 (mean rank=56.76) and against companies founded after 2010 (mean rank=45.81).

8.4.1.2 Geographical area

H_{211}: There is a statistically significant difference in rewarding individuals, groups or companies to provide ideas in the form of a competition or challenge with respect to geographical area that firm operates in.

H_{212}: There is a statistically significant difference in licensing or selling company's own patents and technology to other organizations with respect to geographical area that firm operates in.

H_{213}: There is a statistically significant difference in licensing or buying patents and technology with respect to geographical area that firm operates in.

H_{214}: There is a statistically significant difference in being part of an innovation network with respect to geographical area that firm operates in.

H_{215}: There is a statistically significant difference in getting help from an innovation intermediary with respect to geographical area that firm operates in.

H_{216}: There is a statistically significant difference in developing new products through collaborating with customers, suppliers, or other 3^{rd} party partners with respect to geographical area that firm operates in.

H_{217}: There is a statistically significant difference in observing customer-product interaction process to enhance good or services with respect to geographical area that firm operates in.

H_{218}: There is a statistically significant difference in identifying innovations added to company's own product by users and then incorporating these ideas back into products with respect to geographical area that firm operates in.

H_{219}: There is a statistically significant difference in providing a platform that customers can extend the capabilities of the products with respect to geographical area that firm operates in.

To test hypotheses, Kruskal-Wallis Test has been performed because of the fact that variables are not normally distributed and there are more than two groups of geographical areas. Geographical regions are listed below.

- Marmara Region,
- Aegean Region,
- Mediterranean Region,
- Black Sea Region,
- Central Anatolia Region,
- Eastern Anatolia Region,
- Southeastern Anatolia Region

Table 8.35 shows statistics of Kruskal-Wallis Test for all hypotheses regarding open innovation practices and geographical area.

Table 8.35 : Kruskal-Wallis test results for open innovation practices and geographical area.

Open innovation Practices	Chi-Square	Df	Asymp. Sig.
Idea competitions/challenges	5,251	6	,512
IP or tech-out licensing or selling	3,185	6	,785
IP or tech-in licensing or acquisition	6,533	6	,366
Innovation network	3,796	6	,704
Innovation intermediaries	2,084	6	,912
Collaboration	8,236	6	,221
Customer immersion	8,486	6	,205
Lead users	12,550	6	,051
Platforming	11,377	6	,077

Test statistics show that all p-values are greater than 0.05 (0.512, 0.785, 0.366, 0.704, 0.912, 0.221, 0.205, 0.051, and 0.077).So, hypotheses H_{211}, H_{212}, H_{213}, H_{214}, H_{215}, H_{216}, H_{217}, H_{218}, and H_{219} have been rejected. It can be said that there is not a significant difference in practicing open innovation approaches with respect to geographical area that a company operates in.

H_{221}: There is a statistically significant difference in importance level of accelerating time to complete R&D as a motivation factor during the use of open innovation with respect to geographical area that a company operates in.

H_{222}: There is a statistically significant difference in importance level of minimizing risk of innovation projects as a motivation factor during the use of open innovation with respect to geographical area that a company operates in.

H_{223}: There is a statistically significant difference in importance level of reducing R&D costs per project as a motivation factor during the use of open innovation with respect to geographical area that a company operates in.

H_{224}: There is a statistically significant difference in importance level of exploring new technological trends as a motivation factor during the use of open innovation with respect to geographical area that a company operates in.

H_{225}: There is a statistically significant difference in importance level of identifying new business opportunities as a motivation factor during the use of open innovation with respect to geographical area that a company operates in.

H_{226}: There is a statistically significant difference in importance level of establishing new partnerships as a motivation factor during the use of open innovation with respect to geographical area that a company operates in.

To test hypotheses, Kruskal-Wallis Test has been performed because of the fact that variables are not normally distributed and there are more than two groups of geographical areas (Marmara Region, Aegean Region, Mediterranean Region, Black Sea Region, Central Anatolia Region, Eastern Anatolia Region, and Southeastern Anatolia Region). Table 8.36 shows statistics of Kruskal-Wallis Test for all hypotheses regarding motives to practice open innovation and geographical area, in which a company operates.

Table 8.36 : Kruskal-Wallis test results for motives to open innovation and geographical area.

Motives to Open Innovation	Chi-Square	Df	Asymp. Sig.
Accelerating time to complete R&D	4,323	6	,633
Minimizing risk of innovation projects	13,204	6	,040
Reducing R&D costs per project	8,829	6	,183
Exploring new technological trends	2,390	6	,881
Identifying new business opportunities	6,316	6	,389
Establishing new partnerships	5,724	6	,455

According to Kruskal-Wallis Test statistics, p-values of accelerating time to complete R&D, reducing R&D costs per project, exploring new technological trends, identifying business opportunities, and establishing new partnerships are greater than significance level ($p>0.05$). Therefore, hypotheses H_{221}, H_{223}, H_{224}, H_{225}, and H_{226} have been rejected. There is not a statistically significant difference in these motives with respect geographical area that a company operates in.

On the other side, H_{222} has been accepted ($p<0.05$). In that case, there is a statistically significant difference in importance level of minimizing risk of innovation projects as a motivation factor during the use of open innovation with respect to geographical area that a company operates in. Mann-Whitney U Test has been performed to understand which groups are different from each other significantly (see Table 8.37).

Table 8.37 : Mann-Whitney U test results for minimizing risk of innovation projects and geographical area.

Mean Rank	**U**	**P**
Marmara$_{(49,53)}$ > Mediterranean$_{(16,21)}$	45,000	,003
Aegean$_{(59,50)}$ > Mediterrenean$_{(16,21)}$	3,500	,010
Black Sea$_{(41,30)}$ >Meditertanean$_{(16,21)}$	5,500	,043
Central Anatolia$_{(54,06)}$ > Mediterranean$_{(16,21)}$	21,500	,001
Eastern Anatolia$_{(52,07)}$ > Mediterranean$_{(16,21)}$	6,500	,016
Southeastern Anatolia$_{(54,20)}$ > Mediterranean$_{(16,21)}$	3,500	,019

Results show that all differences militate against companies that operate in Mediterranean Region. Minimizing risk of innovation projects as a motive to open innovation is more important to companies that operate in other geographical regions in comparison with companies that operate in Mediterranean Region.

H_{231}: There is a statistically significant difference in frequencies of encountering constraints regarding confidentiality and conservativeness during the use of open innovation with respect to geographical area that a company operates in.

H_{232}: There is a statistically significant difference in frequencies of encountering constraints regarding human resources, brand and image during the use of open innovation with respect to geographical area that a company operates in.

H_{233}: There is a statistically significant difference in frequencies of encountering constraints regarding resources and costs during the use of open innovation with respect to geographical area that a company operates in.

H_{234}: There is a statistically significant difference in frequencies of encountering constraints regarding management and organization during the use of open innovation with respect to geographical area that a company operates in.

H_{235}: There is a statistically significant difference in frequencies of encountering constraints regarding market, partnership and technology sources during the use of open innovation with respect to geographical area that a company operates in.

H_{236}: There is a statistically significant difference in frequencies of encountering administrative constraints during the use of open innovation with respect to geographical area that a company operates in.

To test hypotheses, ANOVA Test has been performed because of the fact that variables are normally distributed and there are more than two groups of geographical areas (Marmara Region, Aegean Region, Mediterranean Region, Black Sea Region, Central Anatolia Region, Eastern Anatolia Region, and Southeastern Anatolia Region). Table 8.38 shows statistics of ANOVA Test for all hypotheses regarding constraints on open innovation and geographical area that companies operate in.

Table 8.38 : ANOVA test results for constraints on open innovation and geographical area.

		Sum of Squares	**Df**	**Mean Square**	**F**	**Sig.**
Confidentiality, conservativeness	Between Groups	1,221	6	,203	,234	,964
	Within Groups	78,106	90	,868		
	Total	79,326	96			
Human resources, brand and image	Between Groups	5,893	6	,982	1,143	,344
	Within Groups	77,320	90	,859		
	Total	83,213	96			
Resources and costs	Between Groups	5,395	6	,899	1,063	,391
	Within Groups	76,146	90	,846		
	Total	81,541	96			
Management and organization	Between Groups	3,383	6	,564	,704	,647
	Within Groups	72,072	90	,801		
	Total	75,455	96			
Market, partnership and technology sources	Between Groups	4,247	6	,708	,822	,556
	Within Groups	77,489	90	,861		
	Total	81,737	96			
Administrative	Between Groups	8,176	6	1,363	1,151	,339
	Within Groups	106,509	90	1,183		
	Total	114,686	96			

According to test results, all p-values are greater than 0.05 (0.964, 0.344, 0.391, 0.647, 0.556, and 0.339 respectively). Thus, hypotheses H_{231}, H_{232}, H_{233}, H_{234}, H_{235}, and H_{236} have been rejected. It is clear that there is not a statistically significant

difference in frequencies of encountering constraints on open innovation with respect to geographical area that a company operates in.

H_{241}: There is a statistically significant difference in importance level of increasing the working hours as an action to compensate the constraints with respect to geographical area that a company operates in.

H_{242}: There is a statistically significant difference in importance level of increasing product differentiation as an action to compensate the constraints with respect to geographical area that a company operates in.

H_{243}: There is a statistically significant difference in importance level of looking for different markets as an action to compensate the constraints with respect to geographical area that a company operates in.

H_{244}: There is a statistically significant difference in importance level of reducing prices of products as an action to compensate the constraints with respect to geographical area that a company operates in.

H_{245}: There is a statistically significant difference in importance level of improving quality of products as an action to compensate the constraints with respect to geographical area that a company operates in.

H_{246}: There is a statistically significant difference in importance level of looking for market niches as an action to compensate the constraints with respect to geographical area that a company operates in.

H_{247}: There is a statistically significant difference in importance level of improving marketing activities as an action to compensate the constraints with respect to geographical area that a company operates in.

H_{248}: There is a statistically significant difference in importance level of forming strategic partnerships as an action to compensate the constraints with respect to geographical area that a company operates in.

H_{249}: There is a statistically significant difference in importance level of reducing production as an action to compensate the constraints with respect to geographical area that a company operates in.

H_{2410}: There is a statistically significant difference in importance level of reducing production costs as an action to compensate the constraints with respect to geographical area that a company operates in.

To test hypotheses, Kruskal-Wallis Test has been performed because of the fact that variables are not normally distributed and there are more than two groups of geographical areas (Marmara Region, Aegean Region, Mediterranean Region, Black Sea Region, Central Anatolia Region, Eastern Anatolia Region, and Southeastern Anatolia Region). Table 8.39 shows statistics of Kruskal-Wallis Test for all hypotheses regarding actions to compensate barriers on competition and geographical areas that companies operate in.

Table 8.39 : Kruskal-Wallis test results for actions to compensate barriers on competition and geographical area.

Actions	Chi-Square	Df	Asymp. Sig.
Increasing the working hours	6,225	6	,398
Increasing product differentiation	6,788	6	,341
Looking for different markets	5,418	6	,491
Reducing prices of goods/services	3,216	6	,781
Improving quality of goods/services	1,256	6	,974
Looking for market niches	8,066	6	,233
Improving marketing activities	1,562	6	,955
Forming strategic partnerships	3,188	6	,785
Reducing production	5,346	6	,500
Reducing production costs	9,288	6	,158

According to Kruskal-Wallis Test results, all p-values are greater than 0.05 (0.398, 0.341, 0.491, 0.781, 0.974, 0.233, 0.955, 0.785, 0.500, and 0.158 respectively). Therefore, there is not a statistically significant difference in actions to compensate barriers on competition with respect to geographical area that companies operate in. Hypotheses H_{241}, H_{242}, H_{243}, H_{244}, H_{245}, H_{246}, H_{247}, H_{248}, H_{249}, and H_{2410} have been rejected.

H_{251}: There is a statistically significant difference in importance level of employees as a collaborating partner during the development of innovation with respect to geographical area that a company operates in.

H_{252}: There is a statistically significant difference in importance level of consultants as a collaborating partner during the development of innovation with respect to geographical area that a company operates in.

H_{253}: There is a statistically significant difference in importance level of support and incentive funds as a collaborating partner during the development of innovation with respect to geographical area that a company operates in.

H_{254}: There is a statistically significant difference in importance level of development agencies as a collaborating partner during the development of innovation with respect to geographical area that a company operates in.

H_{255}: There is a statistically significant difference in importance level of customers as a collaborating partner during the development of innovation with respect to geographical area that a company operates in.

H_{256}: There is a statistically significant difference in importance level of competitor companies as a collaborating partner during the development of innovation with respect to geographical area that a company operates in.

H_{257}: There is a statistically significant difference in importance level of suppliers and stakeholders as a collaborating partner during the development of innovation with respect to geographical area that a company operates in.

H_{258}: There is a statistically significant difference in importance level of technology transfer offices as a collaborating partner during the development of innovation with respect to geographical area that a company operates in.

H_{259}: There is a statistically significant difference in importance level of universities and other academic institutions as a collaborating partner during the development of innovation with respect to geographical area that a company operates in.

Kruskal-Wallis Test has been performed because of the fact that variables are not normally distributed and there are more than two groups of geographical areas(Marmara Region, Aegean Region, Mediterranean Region, Black Sea Region, Central Anatolia Region, Eastern Anatolia Region, and Southeastern Anatolia Region) to test hypotheses. Table 8.40 shows statistics of Kruskal-Wallis Test for all hypotheses regarding collaborating partners and geographical area that companies operate in.

Table 8.40 : Kruskal-Wallis test results for collaborating partners and geographical area.

Collaborating Partners	Chi-Square	Df	Asymp. Sig.
Employees	6,082	6	,414
Consultants	8,729	6	,189
Support and incentive funds	7,265	6	,297
Development agencies	14,237	6	,027
Customers	7,554	6	,273
Competitor Companies	13,603	6	,034
Suppliers/stakeholders	12,179	6	,058
Technology transfer offices	7,248	6	,299
Universities and other academic institutions	5,141	6	,526

Hypotheses H_{251}, H_{252}, H_{253}, H_{255}, H_{257}, H_{258}, and H_{259} have been rejected ($p>0.05$). As it is, there is not a statistically significant difference in importance level of collaborating partners with respect to geographical area that a company operates in. However, hypotheses H_{254} and H_{256} have been accepted ($p<0.05$). There is a statistically significant difference in importance level of development agencies as a collaborating partner and in importance level of competitor companies as a collaborating partner with respect to geographical region. In order to understand which geographical areas are different from each other, Mann-Whitney U Test has been performed (see Table 8.41).

Table 8.41 : Mann-Whitney U test results for collaborating partners and geographical area.

Development Agencies			Competitor Companies		
Mean Rank	**U**	**p**	**Mean Rank**	**U**	**p**
$Mediterranean_{(75,63)}$ > $Marmara_{(41,72)}$	59,500	,003	$Marmara_{(50,71)}$ > $Black\ Sea_{(25,20)}$	50,500	,046
$Central\ Anatolia_{(58,38)}$ > $Marmara_{(41,72)}$	404,500	,017	$Central\ Anatolia_{(60,52)}$ > $Mediterranean_{(35,88)}$	57,000	,028
			$Eastern\ Anatolia_{(63,50)}$ > $Mediterranean_{(35,88)}$	12,000	,049
			$Central\ Anatolia_{(60,52)}$ > $Black\ Sea_{(25,20)}$	23,500	,016
			$Eastern\ Anatolia_{(63,50)}$ > $Black\ Sea_{(25,20)}$	5,500	,046

8.4.1.3 Target Market

H_{311}: There is a statistically significant difference in rewarding individuals, groups or companies to provide ideas in the form of a competition or challenge with respect to target market of the firm.

H_{312}: There is a statistically significant difference in licensing or selling company's own patents and technology to other organizations with respect to target market of the firm.

H_{313}: There is a statistically significant difference in licensing or buying patents and technology with respect to target market of the firm.

H_{314}: There is a statistically significant difference in being part of an innovation network with respect to target market of the firm.

H_{315}: There is a statistically significant difference in getting help from an innovation intermediary with respect to target market of the firm.

H_{316}: There is a statistically significant difference in developing new products through collaborating with customers, suppliers, or other 3^{rd} party partners with respect to target market of the firm.

H_{317}: There is a statistically significant difference in observing customer-product interaction process to enhance good or services with respect to target market of the firm.

H_{318}: There is a statistically significant difference in identifying innovations added to company's own product by users and then incorporating these ideas back into products with respect to target market of the firm.

H_{319}: There is a statistically significant difference in providing a platform that customers can extend the capabilities of the products with respect to target market of the firm.

There are only two respondent companies of which target market is only external market, these two participants have been counted in both internal and external market.

To test hypotheses, Mann-Whitney U Test has been performed owing to the fact that variables are not normally distributed and there are two groups of target market (only internal market, internal and external market).

Table 8.42 shows statistics of Mann-Whitney U Test for all hypotheses regarding open innovation practices and target market.

Hypotheses H_{311}, H_{312}, H_{313}, H_{315}, and H_{317} have been rejected ($p>0.05$). As it is understood, there is not a statistically significant difference in practicing these open innovation approaches with respect to target market of the firm.

Table 8.42 : Mann-Whitney U test results for open innovation practices and target market.

	Target Market	N	Mean Rank	Sum of Ranks	U	p
Idea competition/challenges	Only internal	22	42,43	933,50	680,500	,087
	Internal and external	80	53,99	4319,50		
	Total	102				
IP or tech-out licensing or selling	Only internal	22	41,84	920,50	667,500	,070
	Internal and external	80	54,16	4332,50		
	Total	102				
IP or tech-in licensing or acquisition	Only internal	22	41,91	922,00	669,000	,074
	Internal and external	80	54,14	4331,00		
	Total	102				
Innovation network	Only internal	22	33,25	731,50	478,500	,000
	Internal and external	80	56,52	4521,50		
	Total	102				
Innovation intermediaries	Only internal	22	42,59	937,00	684,000	,088
	Internal and external	80	53,95	4316,00		
	Total	102				
Collaboration	Only internal	22	39,23	863,00	610,000	,018
	Internal and external	80	54,88	4390,00		
	Total	102				
Customer immersion	Only internal	22	49,09	1080,00	727,000	,629
	Internal and external	80	52,16	4173,00		
	Total	102				
Lead users	Only internal	22	37,41	823,00	570,000	,006
	Internal and external	80	55,38	4430,00		
	Total	102				
Platforming	Only internal	22	37,43	823,50	570,500	,008
	Internal and external	80	55,37	4429,50		
	Total	102				

On the other hand, H_{314} ($p<0.001$), and H_{316}, H_{318}, and H_{319} ($p<0.05$) have been accepted. There is a statistically significant difference in being part of an innovation network with respect to target market of the firm and this difference militates in favor of companies of which target market is both internal and external (mean rank=56.52). Moreover, there is a statistically significant difference in developing new products through collaborating with customers, suppliers, or other 3rd party partners on behalf of companies that target both internal and external market (mean rank=54.88). Also, there is statistically significant difference in identifying innovations added to company's own product by users and then incorporating these ideas back into products with respect to target market of the firm on behalf of companies that target both internal and external market (mean rank=55.38). Lastly, there is a statistically significant difference in providing a platform that customers

can extend the capabilities of the products on behalf of companies of which target market is both internal and external (mean rank=55.37).

H_{321}: There is a statistically significant difference in importance level of accelerating time to complete R&D as a motivation factor during the use of open innovation with respect to target market of the firm.

H_{322}: There is a statistically significant difference in importance level of minimizing risk of innovation projects as a motivation factor during the use of open innovation with respect to target market of the firm.

H_{323}: There is a statistically significant difference in importance level of reducing R&D costs per project as a motivation factor during the use of open innovation with respect to target market of the firm.

H_{324}: There is a statistically significant difference in importance level of exploring new technological trends as a motivation factor during the use of open innovation with respect to target market of the firm.

H_{325}: There is a statistically significant difference in importance level of identifying new business opportunities as a motivation factor during the use of open innovation with respect to target market of the firm.

H_{326}: There is a statistically significant difference in importance level of establishing new partnerships as a motivation factor during the use of open innovation with respect to target market of the firm.

To test hypotheses, Mann-Whitney U Test has been performed because of the fact that variables are not normally distributed and there are two groups of target markets (only internal market, internal and external market). Table 8.43 shows statistics of Mann-Whitney U Test for all hypotheses regarding motives to practice open innovation.

Hypotheses H_{321}, H_{322}, H_{323}, H_{324}, and H_{325} have been rejected owing to the fact that p-values regarding these motivation factors are greater than 0.05 (0.0434, 0.570, 0.777, 0.496, and 0.252 respectively). As it is understood, there is not a statistically significant difference in importance levels of these motives during practicing open innovation with respect to target market of the firm.

Table 8.43 : Mann-Whitney U test results for motives to open innovation and target market.

	Target Market	N	Mean Rank	Sum of Ranks	U	p
Accelerating time to complete R&D	Only internal	21	45,19	949,00	718,000	,434
	Internal and external	76	50,05	3804,00		
	Total	97				
Minimizing risk of innovation projects	Only internal	21	46,07	967,50	736,500	,570
	Internal and external	76	49,81	3785,50		
	Total	97				
Reducing R&D costs per project	Only internal	21	47,55	998,50	767,500	,777
	Internal and external	76	49,40	3754,50		
	Total	97				
Exploring new technological trends	Only internal	21	45,67	959,00	728,000	,496
	Internal and external	76	49,92	3794,00		
	Total	97				
Identifying new business opportunities	Only internal	21	43,33	910,00	679,000	,252
	Internal and external	76	50,57	3843,00		
	Total	97				
Establishing new partnerships	Only internal	21	38,52	809,00	578,000	,047
	Internal and external	76	51,89	3944,00		
	Total	97				

However, hypothesis H_{326} has been accepted ($p<0.05$). In that case, there is a statistically significant difference in importance level of establishing new partnerships as a motive to open innovation in favor of companies which target both internal and external market (mean rank=51.89).

It is a crystal-clear fact that establishing new partnerships provides many advantages. For example, companies can take the advantage of complementary skills of partners, larger pool of capital etc. thanks to new partnerships and it is important for especially companies that operate in both internal and external market.

H_{331}: There is a statistically significant difference in frequencies of encountering constraints regarding confidentiality and conservativeness during the use of open innovation with respect to target market of the firm.

H_{332}: There is a statistically significant difference in frequencies of encountering constraints regarding human resources, brand and image during the use of open innovation with respect to target market of the firm.

H_{333}: There is a statistically significant difference in frequencies of encountering constraints regarding resources and costs during the use of open innovation with respect to target market of the firm.

H_{334}: There is a statistically significant difference in frequencies of encountering constraints regarding management and organization during the use of open innovation with respect to target market of the firm.

H_{335}: There is a statistically significant difference in frequencies of encountering constraints regarding market, partnership and technology sources during the use of open innovation with respect to target market of the firm.

H_{336}: There is a statistically significant difference in frequencies of encountering administrative constraints during the use of open innovation with respect to target market of the firm.

To test hypotheses, t-Test has been performed because of the fact that variables are normally distributed and there are two groups of target markets (only internal market, internal and external market).

Table 8.44 shows statistics of t-Test for all hypotheses regarding constraints on open innovation and target market of the company.

According to t-Test results, there is not a statistically significant difference in frequencies of encountering constraints on open innovation with respect to target market of the firm ($p>0.05$). Therefore, hypotheses H_{331}, H_{332}, H_{333}, H_{334}, H_{335}, and H_{336} have been rejected. In that case, frequency of facing constraints on open innovation does not vary for companies that target both internal and external market and companies that target only internal market.

Table 8.44 : t-Test results for constraints on open innovation and target market.

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Confidentiality, conservativeness	Equal variances assumed	1,288	,259	-,921	95	,360	-,206453634	,224278882	-,651703510	,238796242
	Equal variances not assumed			-,833	28,269	,412	-,206453634	,247729631	-,713687550	,300780282
Human resources, brand and image	Equal variances assumed	,546	,462	-1,862	95	,066	-,42206	,22663	-,87197	,02786
	Equal variances not assumed			-1,918	33,306	,064	-,42206	,22000	-,86948	,02537
Resources and costs	Equal variances assumed	,251	,618	-,929	95	,355	-,21115	,22737	-,66254	,24023
	Equal variances not assumed			-,930	31,986	,359	-,21115	,22708	-,67371	,25140
Management and organization	Equal variances assumed	,010	,921	-1,532	95	,129	-,33255	,21705	-,76344	,09834
	Equal variances not assumed			-1,560	32,755	,128	-,33255	,21313	-,76629	,10119
Market, partnership and technology sources	Equal variances assumed	,000	,993	-,648	95	,519	-,147869674	,228169641	-,600843683	,305104335
	Equal variances not assumed			-,633	30,955	,531	-,147869674	,233529454	-,624184414	,328445066
Administrative	Equal variances assumed	1,337	,250	-,892	95	,375	-,240601504	,269743524	-,776110105	,294907097
	Equal variances not assumed			-,946	34,812	,351	-,240601504	,254349356	-,757057876	,275854868

H_{341}: There is a statistically significant difference in importance level of increasing the working hours as an action to compensate the constraints with respect to target market of the firm.

H_{342}: There is a statistically significant difference in importance level of increasing product differentiation as an action to compensate the constraints with respect to target market of the firm.

H_{343}: There is a statistically significant difference in importance level of looking for different markets as an action to compensate the constraints with respect to target market of the firm.

H_{344}: There is a statistically significant difference in importance level of reducing prices of products as an action to compensate the constraints with respect to target market of the firm.

H_{345}: There is a statistically significant difference in importance level of improving quality of products as an action to compensate the constraints with respect to target market of the firm.

H_{346}: There is a statistically significant difference in importance level of looking for market niches as an action to compensate the constraints with respect to target market of the firm.

H_{347}: There is a statistically significant difference in importance level of improving marketing activities as an action to compensate the constraints with respect to target market of the firm.

H_{348}: There is a statistically significant difference in importance level of forming strategic partnerships as an action to compensate the constraints with respect to target market of the firm.

H_{349}: There is a statistically significant difference in importance level of reducing production as an action to compensate the constraints with respect to target market of the firm.

H_{3410}: There is a statistically significant difference in importance level of reducing production costs as an action to compensate the constraints with respect to target market of the firm.

To test hypotheses, Mann-Whitney U Test has been performed owing to the fact that variables are not normally distributed and there are two groups of target markets (only internal market, internal and external market). Table 8.45 shows statistics of

Mann-Whitney U Test for all hypotheses regarding actions to compensate barriers on competition and target market.

Table 8.45 : Mann-Whitney U test results for actions to compensate barriers on competition and target market.

	Target Market	N	Mean Rank	Sum of Ranks	U	p
Increasing the working hours	Only internal	22	37,05	815,00	562,000	,008
	Internal and external	80	55,48	4438,00		
	Total	102				
Increasing product differentiation	Only internal	22	52,55	1156,00	857,000	,845
	Internal and external	80	51,21	4097,00		
	Total	102				
Looking for different markets	Only internal	22	47,48	1044,50	791,500	,450
	Internal and external	80	52,61	4208,50		
	Total	102				
Reducing prices of goods/services	Only internal	22	42,52	935,50	682,500	,096
	Internal and external	80	53,97	4317,50		
	Total	102				
Improving quality of goods/services	Only internal	22	59,05	1299,00	714,000	,145
	Internal and external	80	49,43	3954,00		
	Total	102				
Looking for market niches	Only internal	22	45,89	1009,50	756,500	,286
	Internal and external	80	53,04	4243,50		
	Total	102				
Improving marketing activities	Only internal	22	57,57	1266,50	746,500	,249
	Internal and external	80	49,83	3986,50		
	Total	102				
Forming strategic partnerships	Only internal	22	48,77	1073,00	820,000	,603
	Internal and external	80	52,25	4180,00		
	Total	102				
Reducing production	Only internal	22	52,00	1144,00	869,000	,925
	Internal and external	80	51,36	4109,00		
	Total	102				
Reducing production costs	Only internal	22	50,84	1118,50	865,500	,902
	Internal and external	80	51,68	4134,50		
	Total	102				

According to test results, H_{342}, H_{343}, H_{344}, H_{345}, H_{346}, H_{347}, H_{348}, H_{349}, and H_{3410} have been rejected. It can be said that there is not a statistically significant difference in these actions to compensate barriers on competition with respect to target market of the firm. On the other hand, H_{341} has been accepted. In the circumstances, there is a statistically significant difference in importance level of increasing working hours to

compensate barriers on competition on behalf of companies of which target market is both internal and external (mean rank=55.48).

H_{351}: There is a statistically significant difference in importance level of employees as a collaborating partner during the development of innovation with respect to target market of the firm.

H_{352}: There is a statistically significant difference in importance level of consultants as a collaborating partner during the development of innovation with respect to target market of the firm.

H_{353}: There is a statistically significant difference in importance level of support and incentive funds as a collaborating partner during the development of innovation with respect to target market of the firm.

H_{354}: There is a statistically significant difference in importance level of development agencies as a collaborating partner during the development of innovation with respect to target market of the firm.

H_{355}: There is a statistically significant difference in importance level of customers as a collaborating partner during the development of innovation with respect to target market of the firm.

H_{356}: There is a statistically significant difference in importance level of competitor companies as a collaborating partner during the development of innovation with respect to target market of the firm.

H_{357}: There is a statistically significant difference in importance level of suppliers and stakeholders as a collaborating partner during the development of innovation with respect to target market of the firm.

H_{358}: There is a statistically significant difference in importance level of technology transfer offices as a collaborating partner during the development of innovation with respect to target market of the firm.

H_{359}: There is a statistically significant difference in importance level of universities and other academic institutions as a collaborating partner during the development of innovation with respect to target market of the firm.

Because of the fact that variables are not normally distributed and there are two groups of target markets (only internal market, internal and external market), Mann-Whitney U Test has been performed. Table 8.46 shows statistics of Mann-Whitney U Test for all hypotheses regarding collaborating partners and target market.

Table 8.46 : Mann-Whitney U test results for collaborating partners and target market.

	Target Market	N	Mean Rank	Sum of Ranks	U	p
Employees	Only internal	22	51,39	1130,50	877,500	,978
	Internal and external	80	51,53	4122,50		
	Total	102				
Consultants	Only internal	22	57,39	1262,50	750,500	,274
	Internal and external	80	49,88	3990,50		
	Total	102				
Support and Incentive Funds	Only internal	22	51,07	1123,50	870,500	,936
	Internal and external	80	51,62	4129,50		
	Total	102				
Development Agencies	Only internal	22	60,11	1322,50	690,500	,114
	Internal and external	80	49,13	3930,50		
	Total	102				
Customers	Only internal	22	59,91	1318,00	695,000	,099
	Internal and external	80	49,19	3935,00		
	Total	102				
Competitor Companies	Only internal	22	48,86	1075,00	822,000	,626
	Internal and external	80	52,23	4178,00		
	Total	102				
Suppliers/ Stakeholders	Only internal	22	42,07	925,50	672,500	,079
	Internal and external	80	54,09	4327,50		
	Total	102				
Technology Transfer Offices	Only internal	22	50,98	1121,50	868,500	,924
	Internal and external	80	51,64	4131,50		
	Total	102				
Universities and Other Academic Institutions	Only internal	22	43,64	960,00	707,000	,150
	Internal and external	80	53,66	4293,00		
	Total	102				

All hypotheses H_{351}, H_{352}, H_{353}, H_{354}, H_{355}, H_{356}, H_{357}, H_{358}, and H_{359}, have been rejected ($p>0.05$). In that case, there is not a significant difference in importance level of any collaborating partners depending on target market of the firm.

8.4.1.4 Firm type

H_{411}: There is a statistically significant difference in rewarding individuals, groups or companies to provide ideas in the form of a competition or challenge with respect to type of the firm.

H_{412}: There is a statistically significant difference in licensing or selling company's own patents and technology to other organizations with respect to type of the firm.

H_{413}: There is a statistically significant difference in licensing or buying patents and technology with respect to type of the firm.

H_{414}: There is a statistically significant difference in being part of an innovation network with respect to type of the firm.

H_{415}: There is a statistically significant difference in getting help from an innovation intermediary with respect to type of the firm.

H_{416}: There is a statistically significant difference in developing new products through collaborating with customers, suppliers, or other 3rd party partners with respect to type of the firm.

H_{417}: There is a statistically significant difference in observing customer-product interaction process to enhance good or services with respect to type of the firm.

H_{418}: There is a statistically significant difference in identifying innovations added to company's own product by users and then incorporating these ideas back into products with respect to type of the firm.

H_{419}: There is a statistically significant difference in providing a platform with respect to type of the firm.

To test hypotheses, Mann-Whitney U Test has been performed because of the fact that variables are not normally distributed and there are two groups of firm type (a subsidiary of an international company, an independent company). Subsidiary companies that are partly or wholly owned by a holding company have little or no financial control over their activities such as investment decisions, and budgeting.

Table 8.47 shows statistics of Mann-Whitney U Test for all hypotheses regarding open innovation practices and type of the firm.

Table 8.47 : Mann-Whitney U test results for open innovation practices and firm type.

	Firm Type	N	Mean Rank	Sum of Ranks	U	p
Idea competition/challenges	A subsidiary	7	60,64	424,50	268,500	,372
	An independent company	95	50,83	4828,50		
	Total	102				
IP or tech-out licensing or selling	A subsidiary	7	48,14	337,00	309,000	,745
	An independent company	95	51,75	4916,00		
	Total	102				
IP or tech-in licensing or acquisition	A subsidiary	7	45,21	316,50	288,500	,545
	An independent company	95	51,96	4936,50		
	Total	102				
Innovation network	A subsidiary	7	64,07	448,50	244,500	,208
	An independent company	95	50,57	4804,50		
	Total	102				
Innovation intermediaries	A subsidiary	7	49,50	346,50	318,500	,843
	An independent company	95	51,65	4906,50		
	Total	102				
Collaboration	A subsidiary	7	67,93	475,50	217,500	,103
	An independent company	95	50,29	4777,50		
	Total	102				
Customer immersion	A subsidiary	7	67,57	473,00	220,000	,095
	An independent company	95	50,32	4780,00		
	Total	102				
Lead users	A subsidiary	7	50,64	354,50	326,500	,931
	An independent company	95	51,56	4898,50		
	Total	102				
Platforming	A subsidiary	7	41,29	289,00	261,000	,321
	An independent company	95	52,25	4964,00		
	Total	102				

All hypotheses H_{411}, H_{412}, H_{413}, H_{414}, H_{415}, H_{416}, H_{417}, H_{418}, and H_{419} have been rejected ($p>0.05$). Ergo, there is not statistically significant difference in practicing open innovation with respect to type of the firm.

H_{421}: There is a statistically significant difference in importance level of accelerating time to complete R&D as a motivation factor during the use of open innovation with respect to type of the firm.

H_{422}: There is a statistically significant difference in importance level of minimizing risk of innovation projects as a motivation factor during the use of open innovation with respect to type of the firm.

H_{423}: There is a statistically significant difference in importance level of reducing R&D costs per project as a motivation factor during the use of open innovation with respect to type of the firm.

H_{424}: There is a statistically significant difference in importance level of exploring new technological trends as a motivation factor during the use of open innovation with respect to type of the firm.

H_{425}: There is a statistically significant difference in importance level of identifying new business opportunities as a motivation factor during the use of open innovation with respect to type of the firm.

H_{426}: There is a statistically significant difference in importance level of establishing new partnerships as a motivation factor during the use of open innovation with respect to type of the firm.

Mann-Whitney U Test has been performed because of the fact that variables are not normally distributed and there are two groups of firm type as a subsidiary of an international company and an independent company (see Table 8.48).

Table 8.48 : Mann-Whitney U test results for motives to open innovation and firm type.

	Firm Type	**N**	**Mean Rank**	**Sum of Ranks**	**U**	**p**
Accelerating time to complete R&D	A subsidiary	7	58,79	411,50	246,500	,286
	An independent company	90	48,24	4341,50		
	Total	97				
Minimizing risk of innovation projects	A subsidiary	7	37,93	265,50	237,500	,254
	An independent company	90	49,86	4487,50		
	Total	97				
Reducing R&D costs per project	A subsidiary	7	40,36	282,50	254,500	,371
	An independent company	90	49,67	4470,50		
	Total	97				
Exploring new technological trends	A subsidiary	7	45,00	315,00	287,000	,665
	An independent company	90	49,31	4438,00		
	Total	97				
Identifying new business opportunities	A subsidiary	7	52,29	366,00	292,000	,725
	An independent company	90	48,74	4387,00		
	Total	97				
Establishing new partnerships	A subsidiary	7	57,00	399,00	259,000	,421
	An independent company	90	48,38	4354,00		
	Total	97				

H_{421}, H_{422}, H_{423}, H_{424}, H_{425}, and H_{426} have been rejected ($p>0.05$) and there is not significant difference in importance levels of any motives to open innovation with respect to type of the firm.

H_{431}: There is a statistically significant difference in frequencies of encountering constraints regarding confidentiality and conservativeness during the use of open innovation with respect to type of the firm.

H_{432}: There is a statistically significant difference in frequencies of encountering constraints regarding human resources, brand and image during the use of open innovation with respect to type of the firm.

H_{433}: There is a statistically significant difference in frequencies of encountering constraints regarding resources and costs during the use of open innovation with respect to type of the firm.

H_{434}: There is a statistically significant difference in frequencies of encountering constraints regarding management and organization during the use of open innovation with respect to type of the firm.

H_{435}: There is a statistically significant difference in frequencies of encountering constraints regarding market, partnership and technology sources during the use of open innovation with respect to type of the firm.

H_{436}: There is a statistically significant difference in frequencies of encountering administrative constraints during the use of open innovation with respect to type of the firm.

Due to the fact that variables are normally distributed and there are two groups of firm type (a subsidiary of an international company, an independent company), t-Test has been performed.

Table 8.49 shows statistics of t-Test for all hypotheses regarding constraints on open innovation and firm type.

Table 8.49 : t-Test results for constraints on open innovation and firm type.

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Confidentiality, conservativeness	Equal variances assumed	,473	,493	,445	95	,658	,159259259	,358188323	-,551834468	,870352987
	Equal variances not assumed			,509	7,337	,626	,159259259	,313117397	-,574299059	,892817578
Human resources, brand and image	Equal variances assumed	,002	,968	1,623	95	,108	,58794	,36225	-,13122	1,30710
	Equal variances not assumed			1,686	7,059	,135	,58794	,34875	-,23534	1,41122
Resources and costs	Equal variances assumed	,165	,686	,711	95	,479	,25794	,36257	-,46185	,97772
	Equal variances not assumed			,685	6,884	,516	,25794	,37638	-,63510	1,15097
Management and organization	Equal variances assumed	,021	,886	-,621	95	,536	-,21667	,34899	-,90951	,47617
	Equal variances not assumed			-,613	6,939	,559	-,21667	,35333	-1,05367	,62034
Market, partnership and technology sources	Equal variances assumed	2,004	,160	-,911	95	,365	-,330158730	,362387226	-1,049588335	,389270874
	Equal variances not assumed			-,676	6,474	,523	-,330158730	,488561035	-1,504735435	,844417974
Administrative	Equal variances assumed	2,832	,096	2,074	95	,041	,874603175	,421688408	,037445839	1,711760510
	Equal variances not assumed			1,576	6,502	,162	,874603175	,555035401	-,458506585	2,207712934

Hypotheses H_{431}, H_{432}, H_{433}, H_{434}, H_{435} have been rejected ($p>0.05$). However, H_{436} has been accepted. In that case, there is a statistically significant difference in frequencies of encountering administrative constraints on open innovation with respect to type of the firm and this difference militates in favor of the firms that are subsidiaries of an international company (mean=3.285) and against independent firms (mean=2.411). It is clear that independent companies face administrative constraints on open innovation more frequently in comparison with companies that are subsidiaries of an international company.

H_{441}: There is a statistically significant difference in importance level of increasing the working hours as an action to compensate the constraints with respect to type of the firm.

H_{442}: There is a statistically significant difference in importance level of increasing product differentiation as an action to compensate the constraints with respect to type of the firm.

H_{443}: There is a statistically significant difference in importance level of looking for different markets as an action to compensate the constraints with respect to type of the firm.

H_{444}: There is a statistically significant difference in importance level of reducing prices of products as an action to compensate the constraints with respect to type of the firm.

H_{445}: There is a statistically significant difference in importance level of improving quality of products as an action to compensate the constraints with respect to type of the firm.

H_{446}: There is a statistically significant difference in importance level of looking for market niches as an action to compensate the constraints with respect to type of the firm.

H_{447}: There is a statistically significant difference in importance level of improving marketing activities as an action to compensate the constraints with respect to type of the firm.

H_{448}: There is a statistically significant difference in importance level of forming strategic partnerships as an action to compensate the constraints with respect to type of the firm.

H_{449}: There is a statistically significant difference in importance level of reducing production as an action to compensate the constraints with respect to type of the firm.

H_{4410}: There is a statistically significant difference in importance level of reducing production costs as an action to compensate the constraints with respect to type of the firm.

Mann-Whitney U Test has been performed because of the fact that variables are not normally distributed and there are two groups of firm type (see Table 8.50).

Table 8.50 : Mann-Whitney U test results for actions to compensate barriers on competition and firm type.

	Firm Type	N	Mean Rank	Sum of Ranks	U	p
Increasing the working hours	A subsidiary	7	39,57	277,00	249,000	,255
	An independent company	95	52,38	4976,00		
	Total	102				
Increasing product differentiation	A subsidiary	7	58,64	410,50	282,500	,489
	An independent company	95	50,97	4842,50		
	Total	102				
Looking for different markets	A subsidiary	7	72,21	505,50	187,500	,044
	An independent company	95	49,97	4747,50		
	Total	102				
Reducing prices of goods/services	A subsidiary	7	47,71	334,00	306,000	,717
	An independent company	95	51,78	4919,00		
	Total	102				
Improving quality of goods/services	A subsidiary	7	57,00	399,00	294,000	,582
	An independent company	95	51,09	4854,00		
	Total	102				
Looking for market niches	A subsidiary	7	68,14	477,00	216,000	,102
	An independent company	95	50,27	4776,00		
	Total	102				
Improving marketing activities	A subsidiary	7	29,07	203,50	175,500	,027
	An independent company	95	53,15	5049,50		
	Total	102				
Forming strategic partnerships	A subsidiary	7	67,79	474,50	218,500	,108
	An independent company	95	50,30	4778,50		
	Total	102				
Reducing production	A subsidiary	7	41,79	292,50	264,500	,346
	An independent company	95	52,22	4960,50		
	Total	102				
Reducing production costs	A subsidiary	7	45,71	320,00	292,000	,575
	An independent company	95	51,93	4933,00		
	Total	102				

Hypotheses H_{441}, H_{442}, H_{444}, H_{445}, H_{446}, H_{448}, H_{449}, and H_{4410} have been rejected ($p>0.05$) and hypotheses H_{443} and H_{447} have been accepted ($p<0.05$). There is a statistically significant difference in importance level of looking for different markets as an action to compensate the constraints on competition in favor of companies that are subsidiaries of an international company (mean rank=72.21). Also, there is a statistically significant difference in importance level of improving marketing activities as an action to compensate the constraints on competition in favor of independent companies (mean rank=53.15).

H_{451}: There is a statistically significant difference in importance level of employees as a collaborating partner during the development of innovation with respect to type of the firm.

H_{452}: There is a statistically significant difference in importance level of consultants as a collaborating partner during the development of innovation with respect to type of the firm.

H_{453}: There is a statistically significant difference in importance level of support and incentive funds as a collaborating partner during the development of innovation with respect to type of the firm.

H_{454}: There is a statistically significant difference in importance level of development agencies as a collaborating partner during the development of innovation with respect to type of the firm.

H_{455}: There is a statistically significant difference in importance level of customers as a collaborating partner during the development of innovation with respect to type of the firm.

H_{456}: There is a statistically significant difference in importance level of competitor companies as a collaborating partner during the development of innovation with respect to type of the firm.

H_{457}: There is a statistically significant difference in importance level of suppliers and stakeholders as a collaborating partner during the development of innovation with respect to type of the firm.

H_{458}: There is a statistically significant difference in importance level of technology transfer offices as a collaborating partner during the development of innovation with respect to type of the firm.

H_{459}: There is a statistically significant difference in importance level of universities and other academic institutions as a collaborating partner during the development of innovation with respect to type of the firm.

Due to the fact that variables are not normally distributed and there are two groups of firm type (a subsidiary of an international company, an independent company), Mann-Whitney U Test has been performed. Table 8.51 shows statistics of Mann-Whitney U Test for all hypotheses regarding collaborating partners and firm type.

Table 8.51 : Mann-Whitney U test results for collaborating partners and firm type.

	Firm Type	**N**	**Mean Rank**	**Sum of Ranks**	**U**	**p**
Employees	A subsidiary	7	56,50	395,50	297,500	,526
	An independent company	95	51,13	4857,50		
	Total	102				
Consultants	A subsidiary	7	48,36	338,50	310,500	,763
	An independent company	95	51,73	4914,50		
	Total	102				
Support and Incentive Funds	A subsidiary	7	36,07	252,50	224,500	,136
	An independent company	95	52,64	5000,50		
	Total	102				
Development Agencies	A subsidiary	7	43,29	303,00	275,000	,435
	An independent company	95	52,11	4950,00		
	Total	102				
Customers	A subsidiary	7	61,21	428,50	264,500	,324
	An independent company	95	50,78	4824,50		
	Total	102				
Competitor Companies	A subsidiary	7	42,71	299,00	271,000	,400
	An independent company	95	52,15	4954,00		
	Total	102				
Suppliers/ Stakeholders	A subsidiary	7	63,36	443,50	249,500	,253
	An independent company	95	50,63	4809,50		
	Total	102				
Technology Transfer Offices	A subsidiary	7	49,71	348,00	320,000	,866
	An independent company	95	51,63	4905,00		
	Total	102				
Universities and Other Academic Institutions	A subsidiary	7	57,86	405,00	288,000	,547
	An independent company	95	51,03	4848,00		
	Total	102				

All hypotheses H_{451}, H_{452}, H_{453}, H_{454}, H_{455}, H_{456}, H_{457}, H_{458}, and H_{459} have been rejected ($p>0.05$). It is clear that there is not a statistically significant difference in importance level of any collaborating partners depending on type of the firm.

8.4.1.5 Employee number

H_{511}: There is a statistically significant difference in rewarding individuals, groups or companies to provide ideas in the form of a competition or challenge with respect to employee number of the firm.

H_{512}: There is a statistically significant difference in licensing or selling company's own patents and technology to other organizations with respect to employee number of the firm.

H_{513}: There is a statistically significant difference in licensing or buying patents and technology with respect to employee number of the firm.

H_{514}: There is a statistically significant difference in being part of an innovation network with respect to employee number of the firm.

H_{515}: There is a statistically significant difference in getting help from an innovation intermediary with respect to employee number of the firm.

H_{516}: There is a statistically significant difference in developing new products through collaborating with customers, suppliers, or other 3^{rd} party partners with respect to employee number of the firm.

H_{517}: There is a statistically significant difference in observing customer-product interaction process to enhance good or services with respect to employee number of the firm.

H_{518}: There is a statistically significant difference in identifying innovations added to company's own product by users and then incorporating these ideas back into products with respect to employee number of the firm.

H_{519}: There is a statistically significant difference in providing a platform that customers can extend the capabilities of the products with respect to employee number of the firm.

To test hypotheses, Kruskal-Wallis Test has been performed because of the fact that variables are not normally distributed and there are more than two groups of

employee number (1-9, 10-49, 50-99, 100-250, and more than 250). Table 8.52 shows statistics of Kruskal-Wallis Test for all hypotheses regarding open innovation practices and number of employees.

Table 8.52 : Kruskal-Wallis test results for open innovation practices and number of employees.

Open innovation Practices	Chi-Square	Df	Asymp. Sig.
Idea competitions/challenges	4,410	4	,353
IP or tech-out licensing or selling	2,453	4	,653
IP or tech-in licensing or acquisition	1,670	4	,796
Innovation network	3,365	4	,499
Innovation intermediaries	,394	4	,983
Collaboration	3,895	4	,420
Customer immersion	2,029	4	,730
Lead users	3,436	4	,488
Platforming	2,091	4	,719

All p-values regarding hypotheses H_{511}, H_{512}, H_{513}, H_{514}, H_{515}, H_{516}, H_{517}, H_{518}, and H_{519} are greater than 0.05 and these hypotheses have been rejected. In that case, there is not a statistically significant difference in practicing open innovation with respect to number of employees.

H_{521}: There is a statistically significant difference in importance level of accelerating time to complete R&D as a motivation factor during the use of open innovation with respect to employee number of the firm.

H_{522}: There is a statistically significant difference in importance level of minimizing risk of innovation projects as a motivation factor during the use of open innovation with respect to employee number of the firm.

H_{523}: There is a statistically significant difference in importance level of reducing R&D costs per project as a motivation factor during the use of open innovation with respect to employee number of the firm.

H_{524}: There is a statistically significant difference in importance level of exploring new technological trends as a motivation factor during the use of open innovation with respect to employee number of the firm.

H_{525}: There is a statistically significant difference in importance level of identifying new business opportunities as a motivation factor during the use of open innovation with respect to employee number of the firm.

H_{526}: There is a statistically significant difference in importance level of establishing new partnerships as a motivation factor during the use of open innovation with respect to employee number of the firm.

To test hypotheses, Kruskal-Wallis Test has been performed because of the fact that variables are not normally distributed and there are more than two groups of employee number (1-9, 10-49, 50-99, 100-250, and more than 250). Table 8.53 shows statistics of Kruskal-Wallis Test for all hypotheses regarding motives to practice open innovation and employee numbers of companies.

Table 8.53 : Kruskal-Wallis test results for motives to open innovation and number of employees.

Motives to Open Innovation	Chi-Square	Df	Asymp. Sig.
Accelerating time to complete R&D	10,667	4	,031
Minimizing risk of innovation projects	3,071	4	,546
Reducing R&D costs per project	3,598	4	,463
Exploring new technological trends	6,611	4	,158
Identifying new business opportunities	5,113	4	,276
Establishing new partnerships	1,431	4	,839

Hypotheses H_{522}, H_{523}, H_{524}, H_{525}, and H_{526} have been rejected ($p>0.05$), but H_{521} has been accepted ($p<0.05$). Then, there is a statistically significant difference in importance level of accelerating time to complete R&D as a motivation factor during the use of open innovation with respect to employee number of the firm. In order to understand which groups are different from each other, Mann-Whitney U Test has been performed (see Table 8.54).

Table 8.54 : Mann-Whitney U test results for motives to open innovation and number of employees.

Mean Rank	U	p
$100\text{-}250_{(60,25)} > 10\text{-}49_{(38,14)}$	52,000	,029
More than $250_{(70,50)} > 10\text{-}49_{(38,14)}$	24,000	,006

As it is seen, there is a statistically significant difference in importance level of accelerating time to complete R&D as a motivation factor during the use of open innovation in favor of companies that have 100-250 employees in comparison with companies that have 10-49 employees. Also, difference militates against companies with 10-49 employees and in favor of companies which have more than 250 employees.

H_{531}: There is a statistically significant difference in frequencies of encountering constraints regarding confidentiality and conservativeness during the use of open innovation with respect to employee number of the firm.

H_{532}: There is a statistically significant difference in frequencies of encountering constraints regarding human resources, brand and image during the use of open innovation with respect to employee number of the firm.

H_{533}: There is a statistically significant difference in frequencies of encountering constraints regarding resources and costs during the use of open innovation with respect to employee number of the firm.

H_{534}: There is a statistically significant difference in frequencies of encountering constraints regarding management and organization during the use of open innovation with respect to employee number of the firm.

H_{535}: There is a statistically significant difference in frequencies of encountering constraints regarding market, partnership and technology sources during the use of open innovation with respect to employee number of the firm.

H_{536}: There is a statistically significant difference in frequencies of encountering administrative constraints during the use of open innovation with respect to employee number of the firm.

To test hypotheses, ANOVA Test has been performed because of the fact that variables are normally distributed and there are more than two groups of employee number (1-9, 10-49, 50-99, 100-250, and more than 250). Table 8.55 shows statistics of ANOVA for all hypotheses regarding constraints on open innovation and number of employees.

Table 8.55 : ANOVA test results for constraints on open innovation and number of employees.

		Sum of Squares	Df	Mean Square	F	Sig.
Confidentiality, conservativeness	Between Groups	2,661	4	,665	,798	,529
	Within Groups	76,665	92	,833		
	Total	79,326	96			
Human resources, brand and image	Between Groups	6,104	4	1,526	1,821	,131
	Within Groups	77,109	92	,838		
	Total	83,213	96			
Resources and costs	Between Groups	1,436	4	,359	,412	,799
	Within Groups	80,105	92	,871		
	Total	81,541	96			
Management and organization	Between Groups	3,187	4	,797	1,014	,404
	Within Groups	72,268	92	,786		
	Total	75,455	96			
Market, partnership and technology sources	Between Groups	4,146	4	1,036	1,229	,304
	Within Groups	77,591	92	,843		
	Total	81,737	96			
Administrative	Between Groups	1,744	4	,436	,355	,840
	Within Groups	112,941	92	1,228		
	Total	114,686	96			

ANOVA shows that there is not a statistically significant difference in frequencies of encountering constraints on open innovation with respect to number of employees owing to the fact that all p-values are greater than 0.05 (0.529, 0.131, 0.799, 0.404, 0.304, and 0.840 respectively).

H_{541}: There is a statistically significant difference in importance level of increasing the working hours as an action to compensate the constraints with respect to employee number of the firm.

H_{542}: There is a statistically significant difference in importance level of increasing product differentiation as an action to compensate the constraints with respect to employee number of the firm.

H_{543}: There is a statistically significant difference in importance level of looking for different markets as an action to compensate the constraints with respect to employee number of the firm.

H_{544}: There is a statistically significant difference in importance level of reducing prices of products as an action to compensate the constraints with respect to employee number of the firm.

H_{545}: There is a statistically significant difference in importance level of improving quality of products as an action to compensate the constraints with respect to employee number of the firm.

H_{546}: There is a statistically significant difference in importance level of looking for market niches as an action to compensate the constraints with respect to employee number of the firm.

H_{547}: There is a statistically significant difference in importance level of improving marketing activities as an action to compensate the constraints with respect to employee number of the firm.

H_{548}: There is a statistically significant difference in importance level of forming strategic partnerships as an action to compensate the constraints with respect to employee number of the firm.

H_{549}: There is a statistically significant difference in importance level of reducing production as an action to compensate the constraints with respect to employee number of the firm.

H_{5410}: There is a statistically significant difference in importance level of reducing production costs as an action to compensate the constraints with respect to employee number of the firm.

Kruskal-Wallis Test has been performed to test hypotheses. Because variables are not normally distributed and there are more than two groups of employee number (1-9, 10-49, 50-99, 100-250, and more than 250). Table 8.56 shows statistics of Kruskal-Wallis Test for all hypotheses regarding actions to compensate barriers on competition and employee number of the company.

Table 8.56 : Kruskal-Wallis test results for actions to compensate barriers on competition and number of employees.

Actions	Chi-Square	Df	Asymp. Sig.
Increasing the working hours	1,341	4	,854
Increasing product differentiation	4,480	4	,345
Looking for different markets	7,002	4	,136
Reducing prices of goods/services	4,782	4	,310
Improving quality of goods/services	2,271	4	,686
Looking for market niches	6,111	4	,191
Improving marketing activities	2,118	4	,714
Forming strategic partnerships	3,296	4	,510
Reducing production	3,095	4	,542
Reducing production costs	5,894	4	,207

All hypotheses $H_{541,}$ $H_{542,}$ $H_{543,}$ $H_{544,}$ $H_{545,}$ $H_{546,}$ $H_{547,}$ $H_{548,}$ $H_{549,}$ and H_{5410} have been rejected ($p>0.05$). Then, there is not a statistically significant difference in importance levels of actions to compensate barriers on competition with respect to employee number of the firm.

H_{551}: There is a statistically significant difference in importance level of employees as a collaborating partner during the development of innovation with respect to employee number of the firm.

H_{552}: There is a statistically significant difference in importance level of consultants as a collaborating partner during the development of innovation with respect to employee number of the firm.

H_{553}: There is a statistically significant difference in importance level of support and incentive funds as a collaborating partner during the development of innovation with respect to employee number of the firm.

H_{554}: There is a statistically significant difference in importance level of development agencies as a collaborating partner during the development of innovation with respect to employee number of the firm.

H_{555}: There is a statistically significant difference in importance level of customers as a collaborating partner during the development of innovation with respect to employee number of the firm.

H_{556}: There is a statistically significant difference in importance level of competitor companies as a collaborating partner during the development of innovation with respect to employee number of the firm.

H_{557}: There is a statistically significant difference in importance level of suppliers and stakeholders as a collaborating partner during the development of innovation with respect to employee number of the firm.

H_{558}: There is a statistically significant difference in importance level of technology transfer offices as a collaborating partner during the development of innovation with respect to employee number of the firm.

H_{559}: There is a statistically significant difference in importance level of universities and other academic institutions as a collaborating partner during the development of innovation with respect to employee number of the firm.

To test hypotheses, Kruskal-Wallis Test has been performed because of the fact that variables are normally distributed and there are more than two groups of employee number (1-9, 10-49, 50-99, 100-250, and more than 250). Table 8.57 shows statistics of Kruskal-Wallis Test for all hypotheses regarding collaborating partners.

Table 8.57 : Kruskal-Wallis test results for collaborating partners and number of employees.

Collaborating Partners	**Chi-Square**	**Df**	**Asymp. Sig.**
Employees	1,568	4	,814
Consultants	1,071	4	,899
Support and incentive funds	3,113	4	,539
Development agencies	1,935	4	,748
Customers	2,689	4	,611
Competitor Companies	7,217	4	,125
Suppliers/stakeholders	,362	4	,985
Technology transfer offices	4,960	4	,291
Universities and other academic institutions	3,702	4	,448

Kruskal-Wallis Test results show that all hypotheses H_{551}, H_{552}, H_{553}, H_{554}, H_{555}, H_{556}, H_{557}, H_{558}, and H_{559} have been rejected ($p>0.05$). In that case, there is not a statistically significant difference in importance level of collaborating partners depending on employee number of the company.

8.4.1.6 Annual turnover

H_{611}: There is a statistically significant difference in rewarding individuals, groups or companies to provide ideas in the form of a competition or challenge with respect to annual turnover of the firm.

H_{612}: There is a statistically significant difference in licensing or selling company's own patents and technology to other organizations with respect to annual turnover of the firm.

H_{613}: There is a statistically significant difference in licensing or buying patents and technology with respect to annual turnover of the firm.

H_{614}: There is a statistically significant difference in being part of an innovation network with respect to annual turnover of the firm.

H_{615}: There is a statistically significant difference in getting help from an innovation intermediary with respect to annual turnover of the firm.

H_{616}: There is a statistically significant difference in developing new products through collaborating with customers, suppliers, or other 3^{rd} party partners with respect to annual turnover of the firm.

H_{617}: There is a statistically significant difference in observing customer-product interaction process to enhance good or services with respect to annual turnover of the firm.

H_{618}: There is a statistically significant difference in identifying innovations added to company's own product by users and then incorporating these ideas back into products with respect to annual turnover of the firm.

H_{619}: There is a statistically significant difference in providing a platform that customers can extend the capabilities of the products with respect to annual turnover of the firm.

Owing to the fact that variables are not normally distributed and there are more than two groups of annual turnover (less than 1 million TL, 1 million TL-8 million TL, 8 million TL-25 million TL, 25 million TL-40 million TL, more than 40 million TL), Kruskal-Wallis Test has been performed to test hypotheses. Table 8.58 shows statistics of Kruskal-Wallis Test for all hypotheses regarding open innovation practices.

Table 8.58 : Kruskal-Wallis test results for open innovation practices and annual turnover.

Open innovation Practices	Chi-Square	Df	Asymp. Sig.
Idea competitions/challenges	7,070	4	,132
IP or tech-out licensing or selling	4,172	4	,383
IP or tech-in licensing or acquisition	1,656	4	,799
Innovation network	2,724	4	,605
Innovation intermediaries	3,091	4	,543
Collaboration	4,717	4	,318
Customer immersion	5,207	4	,267
Lead users	,621	4	,961
Platforming	1,363	4	,851

Kruskal-Wallis Test results show that there is not a statistically significant difference in practicing open innovation with respect to annual turnover of the firm. Because all p-values regarding open innovation are greater than 0.05 significance value (0.132, 0.383, 0.799, 0.605, 0.543, 0.318, 0.267, 0.961, and 0.851 respectively). In that case, H_{611}, H_{612}, H_{613}, H_{614}, H_{615}, H_{616}, H_{617}, H_{618}, and H_{619} have been rejected.

H_{621}: There is a statistically significant difference in importance level of accelerating time to complete R&D as a motivation factor during the use of open innovation with respect to annual turnover of the firm.

H_{622}: There is a statistically significant difference in importance level of minimizing risk of innovation projects as a motivation factor during the use of open innovation with respect to annual turnover of the firm.

H_{623}: There is a statistically significant difference in importance level of reducing R&D costs per project as a motivation factor during the use of open innovation with respect to annual turnover of the firm.

H_{624}: There is a statistically significant difference in importance level of exploring new technological trends as a motivation factor during the use of open innovation with respect to annual turnover of the firm.

H_{625}: There is a statistically significant difference in importance level of identifying new business opportunities as a motivation factor during the use of open innovation with respect to annual turnover of the firm.

H_{626}: There is a statistically significant difference in importance level of establishing new partnerships as a motivation factor during the use of open innovation with respect to annual turnover of the firm.

To test hypotheses, Kruskal-Wallis Test has been performed because of the fact that variables are not normally distributed and there are more than two groups of annual turnover (less than 1 million TL, 1 million TL-8 million TL, 8 million TL-25 million TL, 25 million TL-40 million TL, more than 40 million TL). Table 8.59 shows statistics of Kruskal-Wallis Test for all hypotheses regarding motives to practice open innovation.

Table 8.59 : Kruskal-Wallis test results for motives to open innovation and annual turnover.

Motives to Open Innovation	Chi-Square	Df	Asymp. Sig.
Accelerating time to complete R&D	7,884	4	,096
Minimizing risk of innovation projects	2,953	4	,566
Reducing R&D costs per project	3,872	4	,424
Exploring new technological trends	9,915	4	,042
Identifying new business opportunities	6,057	4	,195
Establishing new partnerships	1,909	4	,753

According to test statistics, hypotheses H_{621}, H_{622}, H_{623}, H_{625}, and H_{626} have been rejected ($p>0.05$). So, there is not a statistically significant difference in importance levels of these motivation factors during the use of open innovation with respect to annual turnover of the firm. On the other hand, hypothesis H_{624} has been accepted ($p<0.05$). In that case, there is statistically significant difference in importance level of exploring new technological trends as a motivation factor during the use of open innovation with respect to annual turnover of the firm. Mann-Whitney U Test has been performed in order to see which groups are different from each other (see Table 8.60).

Table 8.60 : Mann-Whitney U test results for exploring new technological trends and annual turnover.

Mean Rank	U	P
8 million TL-25 million $TL_{(68,59)}$ > Less than 1 million $TL_{(45,41)}$	180,500	,006
8 million TL-25 million $TL_{(68,59)}$ > 1 million TL-8 million $TL_{(44,34)}$	40,500	,007

Mann-Whitney U Test results show that significant difference in importance level of exploring technological trends as a motive to open innovation militates in favor of companies of which annual turnover is between 8 million TL and 25 million TL in comparison with companies of which annual turnover is less than 1 million TL. Additionally, there is a significant difference in importance level of exploring technological trends as a motive to open innovation between companies of which annual turnover is between 8 million TL and 25 million TL and companies of which annual turnover is between 1 million TL and 8 million TL in favor of companies of which annual turnover is between 8 million TL and 25 million TL.

H_{631}: There is a statistically significant difference in frequencies of encountering constraints regarding confidentiality and conservativeness during the use of open innovation with respect to annual turnover of the firm.

H_{632}: There is a statistically significant difference in frequencies of encountering constraints regarding human resources, brand and image during the use of open innovation with respect to annual turnover of the firm.

H_{633}: There is a statistically significant difference in frequencies of encountering constraints regarding resources and costs during the use of open innovation with respect to annual turnover of the firm.

H_{634}: There is a statistically significant difference in frequencies of encountering constraints regarding management and organization during the use of open innovation with respect to annual turnover of the firm.

H_{635}: There is a statistically significant difference in frequencies of encountering constraints regarding market, partnership and technology sources during the use of open innovation with respect to annual turnover of the firm.

H_{636}: There is a statistically significant difference in frequencies of encountering administrative constraints during the use of open innovation with respect to annual turnover of the firm.

To test hypotheses, ANOVA Test has been performed because of the fact that variables are normally distributed and there are more than two groups of annual turnover (less than 1 million TL, 1 million TL-8 million TL, 8 million TL-25 million TL, 25 million TL-40 million TL, more than 40 million TL). Table 8.61 shows

statistics of ANOVA for all hypotheses regarding constraints on open innovation and annual turnover.

Table 8.61 : ANOVA test results for constraints on open innovation and annual turnover.

		Sum of Squares	Df	Mean Square	F	Sig.
Confidentiality, conservativeness	Between Groups	3,600	4	,900	1,093	,365
	Within Groups	75,727	92	,823		
	Total	79,326	96			
Human resources, brand and image	Between Groups	4,779	4	1,195	1,401	,240
	Within Groups	78,435	92	,853		
	Total	83,213	96			
Resources and costs	Between Groups	4,533	4	1,133	1,354	,256
	Within Groups	77,008	92	,837		
	Total	81,541	96			
Management and organization	Between Groups	2,078	4	,520	,651	,627
	Within Groups	73,377	92	,798		
	Total	75,455	96			
Market, partnership and technology sources	Between Groups	3,729	4	,932	1,099	,362
	Within Groups	78,007	92	,848		
	Total	81,737	96			
Administrative	Between Groups	8,093	4	2,023	1,746	,147
	Within Groups	106,592	92	1,159		
	Total	114,686	96			

One way ANOVA results show that all hypotheses H_{631}, H_{632}, H_{633}, H_{634}, H_{635}, and H_{636} have been rejected due to the fact that p-values of these hypotheses are greater than 0.05 (0.365, 0.240, 0.256, 0.627, 0.362, and 0.147 respectively). In the circumstances, there is not a statistically significant difference in frequencies of encountering constraints on open innovation with respect to annual turnover of the company.

H_{641}: There is a statistically significant difference in importance level of increasing the working hours as an action to compensate the constraints with respect to annual turnover of the firm.

H_{642}: There is a statistically significant difference in importance level of increasing product differentiation as an action to compensate the constraints with respect to annual turnover of the firm.

H_{643}: There is a statistically significant difference in importance level of looking for different markets as an action to compensate the constraints with respect to annual turnover of the firm.

H_{644}: There is a statistically significant difference in importance level of reducing prices of products as an action to compensate the constraints with respect to annual turnover of the firm.

H_{645}: There is a statistically significant difference in importance level of improving quality of products as an action to compensate the constraints with respect to annual turnover of the firm.

H_{646}: There is a statistically significant difference in importance level of looking for market niches as an action to compensate the constraints with respect to annual turnover of the firm.

H_{647}: There is a statistically significant difference in importance level of improving marketing activities as an action to compensate the constraints with respect to annual turnover of the firm.

H_{648}: There is a statistically significant difference in importance level of forming strategic partnerships as an action to compensate the constraints with respect to annual turnover of the firm.

H_{649}: There is a statistically significant difference in importance level of reducing production as an action to compensate the constraints with respect to annual turnover of the firm.

H_{6410}: There is a statistically significant difference in importance level of reducing production costs as an action to compensate the constraints with respect to annual turnover of the firm.

To test hypotheses, Kruskal-Wallis Test has been performed because of the fact that variables are not normally distributed and there are more than two groups of annual turnover (less than 1 million TL, 1 million TL-8 million TL, 8 million TL-25 million TL, 25 million TL-40 million TL, more than 40 million TL). Table 8.62 shows

statistics of Kruskal-Wallis Test for all hypotheses regarding actions to compensate barriers on competition and annual turnover.

Table 8.62 : Kruskal-Wallis test results for actions to compensate barriers on open innovation and annual turnover.

Actions	Chi-Square	Df	Asymp. Sig.
Increasing the working hours	1,795	4	,773
Increasing product differentiation	2,968	4	,563
Looking for different markets	10,810	4	,029
Reducing prices of goods/services	3,457	4	,485
Improving quality of goods/services	2,099	4	,718
Looking for market niches	3,704	4	,447
Improving marketing activities	1,407	4	,843
Forming strategic partnerships	2,302	4	,680
Reducing production	5,967	4	,202
Reducing production costs	2,046	4	,727

Hypotheses H_{641}, H_{642}, H_{644}, H_{645}, H_{646}, H_{647}, H_{648}, H_{649}, and H_{6410} have been rejected ($p>0.05$). On the other side, H_{643} has been accepted due to the fact that p-value is greater than 0.05. In that case, there is a statistically significant difference in importance level of looking for different markets as an action to compensate the constraints on competition with respect to annual turnover of the firm. Mann-Whitney U Test has been performed to see which groups are different from each other (see Table 8.63).

Table 8.63 : Mann-Whitney U test results for looking for different markets and annual turnover.

Mean Rank	U	p
8 million TL-25 million $TL_{(68,18)}$ > Less than 1 million $TL_{(49,48)}$	185,000	,009

Mann-Whitney U Test results show that there is a significant difference at in importance level of looking for different markets as an action to compensate barriers on competition in favor of companies of which annual turnover is between 8 million TL and 25 million TL (mean rank=68.18) in comparison with companies of which annual turnover is less than 1 million TL (mean rank=49.48).

H_{651}: There is a statistically significant difference in importance level of employees as a collaborating partner during the development of innovation with respect to annual turnover of the firm.

H_{652}: There is a statistically significant difference in importance level of consultants as a collaborating partner during the development of innovation with respect to annual turnover of the firm.

H_{653}: There is a statistically significant difference in importance level of support and incentive funds as a collaborating partner during the development of innovation with respect to annual turnover of the firm.

H_{654}: There is a statistically significant difference in importance level of development agencies as a collaborating partner during the development of innovation with respect to annual turnover of the firm.

H_{655}: There is a statistically significant difference in importance level of customers as a collaborating partner during the development of innovation with respect to annual turnover of the firm.

H_{656}: There is a statistically significant difference in importance level of competitor companies as a collaborating partner during the development of innovation with respect to annual turnover of the firm.

H_{657}: There is a statistically significant difference in importance level of suppliers and stakeholders as a collaborating partner during the development of innovation with respect to annual turnover of the firm.

H_{658}: There is a statistically significant difference in importance level of technology transfer offices as a collaborating partner during the development of innovation with respect to annual turnover of the firm.

H_{659}: There is a statistically significant difference in importance level of universities and other academic institutions as a collaborating partner during the development of innovation with respect to annual turnover of the firm.

Owing to the fact that variables are not normally distributed and there are more than two groups of annual turnover (less than 1 million TL, 1 million TL-8 million TL, 8 million TL-25 million TL, 25 million TL-40 million TL, more than 40 million TL), Kruskal-Wallis Test has been performed to test hypotheses. Table 8.64 shows

statistics of Kruskal-Wallis Test for all hypotheses regarding collaborating partners and annual turnover.

Table 8.64 : Kruskal-Wallis test results for collaborating partners and annual turnover.

Collaborating Partners	Chi-Square	Df	Asymp. Sig.
Employees	,474	4	,976
Consultants	8,128	4	,087
Support and incentive funds	8,751	4	,068
Development agencies	7,064	4	,133
Customers	6,048	4	,196
Competitor Companies	2,014	4	,733
Suppliers/stakeholders	3,103	4	,541
Technology transfer offices	4,279	4	,370
Universities and other academic institutions	5,908	4	,206

According to test statistics, all p-values are greater than 0.05 (0.976, 0.087, 0.068, 0.133, 0.196, 0.733, 0.541, 0.370, and 0.206 respectively). Therefore, hypotheses H_{651}, H_{652}, H_{653}, H_{654}, H_{655}, H_{656}, H_{657}, H_{658}, and H_{659} have been rejected. There is not a statistically significant difference in importance level of collaborating partners with respect to annual turnover of the company.

8.4.1.7 Innovation

H_{711}: There is a statistically significant difference in rewarding individuals, groups or companies to provide ideas in the form of a competition or challenge with respect to developer of product innovation.

H_{712}: There is a statistically significant difference in licensing or selling company's own patents and technology to other organizations with respect to developer of product innovation.

H_{713}: There is a statistically significant difference in licensing or buying patents and technology with respect to developer of product innovation.

H_{714}: There is a statistically significant difference in being part of an innovation network with respect to developer of product innovation.

H_{715}: There is a statistically significant difference in getting help from an innovation intermediary with respect to developer of product innovation.

H_{716}: There is a statistically significant difference in developing new products through collaborating with customers, suppliers, or other 3rd party partners with respect to developer of product innovation.

H_{717}: There is a statistically significant difference in observing customer-product interaction process to enhance good or services with respect to developer of product innovation.

H_{718}: There is a statistically significant difference in identifying innovations added to company's own product by users and then incorporating these ideas back into products with respect to developer of product innovation.

H_{719}: There is a statistically significant difference in providing a platform that customers can extend the capabilities of the products with respect to developer of product innovation.

Because of the fact that variables are not normally distributed and there are two groups, Mann-Whitney U Test has been performed. "Enterprise together with other enterprises or institutions", "enterprise by adapting or modifying goods or services originally", and "other enterprises or institutions" were considered as one group and named as "other".

Table 8.65 shows Mann-Whitney U Test results regarding developer of product innovation and open innovation practices.

All hypotheses regarding open innovation practices and developers of product innovation have been rejected ($p>0.05$). In that case, there is not a statistically significant difference in practicing open innovation depending on developers of product innovation.

Table 8.65 : Mann-Whitney U test results for open innovation practices and developer of product innovation.

	Developer of Product Innovation	N	Mean Rank	Sum of Ranks	U	p
Idea competition/challenges	Enterprise by itself	72	51,69	3721,50	1066,500	,917
	Other	30	51,05	1531,50		
	Total	102				
IP or tech-out licensing or selling	Enterprise by itself	72	50,41	3629,50	1001,500	,546
	Other	30	54,12	1623,50		
	Total	102				
IP or tech-in licensing or acquisition	Enterprise by itself	72	49,33	3551,50	923,500	,232
	Other	30	56,72	1701,50		
	Total	102				
Innovation network	Enterprise by itself	72	48,39	3484,00	856,000	,075
	Other	30	58,97	1769,00		
	Total	102				
Innovation intermediaries	Enterprise by itself	72	48,70	3506,50	878,500	,114
	Other	30	58,22	1746,50		
	Total	102				
Collaboration	Enterprise by itself	72	49,33	3552,00	924,000	,219
	Other	30	56,70	1701,00		
	Total	102				
Customer immersion	Enterprise by itself	72	51,09	3678,50	1050,500	,808
	Other	30	52,48	1574,50		
	Total	102				
Lead users	Enterprise by itself	72	50,66	3647,50	1019,500	,629
	Other	30	53,52	1605,50		
	Total	102				
Platforming	Enterprise by itself	72	51,69	3721,50	1066,500	,917
	Other	30	51,05	1531,50		
	Total	102				

H_{721}: There is a statistically significant difference in rewarding individuals, groups or companies to provide ideas in the form of a competition or challenge with respect to developer of process innovation.

H_{722}: There is a statistically significant difference in licensing or selling company's own patents and technology to other organizations with respect to developer of process innovation.

H_{723}: There is a statistically significant difference in licensing or buying patents and technology with respect to developer of process innovation.

H_{724}: There is a statistically significant difference in being part of an innovation network with respect to developer of process innovation.

H_{725}: There is a statistically significant difference in getting help from an innovation intermediary with respect to developer of process innovation.

H_{726}: There is a statistically significant difference in developing new products through collaborating with customers, suppliers, or other 3rd party partners with respect to developer of process innovation.

H_{727}: There is a statistically significant difference in observing customer-product interaction process to enhance good or services with respect to developer of process innovation.

H_{728}: There is a statistically significant difference in identifying innovations added to company's own product by users and then incorporating these ideas back into products with respect to developer of process innovation.

H_{729}: There is a statistically significant difference in providing a platform that customers can extend the capabilities of the products with respect to developer of process innovation.

To test hypotheses, Mann-Whitney U Test has been performed due to the fact that variables are not normally distributed and there are two groups. "Enterprise together with other enterprises or institutions", "enterprise by adapting or modifying processes originally", and "other enterprises or institutions" were considered as one group and named as "other". Table 8.66 shows Mann-Whitney U Test results regarding developer of process innovation and open innovation practices.

Hypotheses H_{721}, H_{722}, H_{723}, H_{724}, H_{725}, H_{727}, H_{728}, and H_{729} have been rejected owing to the fact that p-values are greater than 0.05 (0.275, 0.924, 0.583, 0.120, 0.355, 0.435, 0.994, and 0.689 respectively). Therefore, there is not a significant difference in these open innovation practices with respect to developer of process innovation. On the other hand, H_{726} has been accepted ($p<0.05$). It can be said that there is a statistically significant difference in developing new products through collaborating with customers, suppliers, or other 3rd party partners with respect to developer of process innovation. This difference militates in favor of enterprises who develop process innovations together with other enterprises or institutions, enterprises who develop process innovation by adapting or modifying processes of

other enterprises or institutions, and enterprises who have other enterprises or institutions make process innovations (mean rank=59.39) and difference militates against enterprises who develop process innovations on their own (mean rank=47.20).

Table 8.66 : Mann-Whitney U test results for open innovation practices and developer of process innovation.

	Developer of Process Innovation	**N**	**Mean Rank**	**Sum of Ranks**	**U**	**p**
Idea competition/challenges	Enterprise by itself	66	53,74	3547,00	1040,000	,275
	Other	36	47,39	1706,00		
	Total	102				
IP or tech-out licensing or selling	Enterprise by itself	66	51,70	3412,00	1175,000	,924
	Other	36	51,14	1841,00		
	Total	102				
IP or tech-in licensing or acquisition	Enterprise by itself	66	50,36	3323,50	1112,500	,583
	Other	36	53,60	1929,50		
	Total	102				
Innovation network	Enterprise by itself	66	48,39	3193,50	982,500	,120
	Other	36	57,21	2059,50		
	Total	102				
Innovation intermediaries	Enterprise by itself	66	49,63	3275,50	1064,500	,355
	Other	36	54,93	1977,50		
	Total	102				
Collaboration	Enterprise by itself	66	47,20	3115,00	904,100	,033
	Other	36	59,39	2138,00		
	Total	102				
Customer immersion	Enterprise by itself	66	49,99	3299,50	1088,500	,435
	Other	36	54,26	1953,50		
	Total	102				
Lead users	Enterprise by itself	66	51,48	3398,00	1187,000	,994
	Other	36	51,53	1855,00		
	Total	102				
Platforming	Enterprise by itself	66	52,33	3453,50	1133,500	,689
	Other	36	49,99	1799,50		
	Total	102				

H_{731}: There is a statistically significant difference in rewarding individuals, groups or companies to provide ideas in the form of a competition or challenge with respect to level of product innovation.

H_{732}: There is a statistically significant difference in licensing or selling company's own patents and technology to other organizations with respect to level of product innovation.

H_{733}: There is a statistically significant difference in licensing or buying patents and technology with respect to level of product innovation.

H_{734}: There is a statistically significant difference in being part of an innovation network with respect to level of product innovation.

H_{735}: There is a statistically significant difference in getting help from an innovation intermediary with respect to level of product innovation.

H_{736}: There is a statistically significant difference in developing new products through collaborating with customers, suppliers, or other 3^{rd} party partners with respect to level of product innovation.

H_{737}: There is a statistically significant difference in observing customer-product interaction process to enhance good or services with respect to level of product innovation.

H_{738}: There is a statistically significant difference in identifying innovations added to company's own product by users and then incorporating these ideas back into products with respect to level of product innovation.

H_{739}: There is a statistically significant difference in providing a platform that customers can extend the capabilities of the products with respect to level of product innovation.

Mann-Whitney U test has been performed in order to test hypotheses. Because the variables are not normally distributed and there are only two groups. Groups are product innovations that are new to market and other (product innovations that are new to the firm and companies that have not made a product innovation during the last three years). Table 8.67 shows Mann-Whitney U Test results regarding degree of product innovation and open innovation practices.

Hypotheses H_{733}, H_{734}, H_{735}, H_{736}, and H_{739} have been rejected ($p>0.05$). Ip or tech-in licensing or acquisition, innovation network, innovation intermediaries, collaboration, and platforming are not affected by level of product innovation. However, H_{731} ($p<0.05$), H_{732} ($p<0.01$), H_{737} ($p<0.05$), and H_{738} ($p<0.01$) have been

accepted. There is a statistically significant difference in using idea competitions or challenges in favor of companies that have introduced a product innovation new to market during the last three years (mean rank=55.09) and against other companies (mean rank=41.59). Also, there is a statistically significant difference in IP or tech-out licensing or selling in favor of companies that have made a product innovation new to market (mean rank=56.81). Furthermore, observing customer-product interaction process to enhance good or services statistically differs in favor of companies that have made a product innovation new to market during the last three years (mean rank=55) and against (mean rank=41.78). Finally, there is a statistically significant difference in identifying innovations added to company's own product by users and then incorporating these ideas back into products with respect to level of product innovation in favor of companies that have introduced product innovations to the market during the last three years (mean rank=56.70).

Table 8.67 : Mann-Whitney U test results for open innovation practices and degree of product innovation.

	New to Market Product Innovation	**N**	**Mean Rank**	**Sum of Ranks**	**U**	**p**
Idea competition/challenges	Yes	75	55,09	4131,50	743,500	,032
	No	27	41,54	1121,50		
	Total	102				
IP or tech-out licensing or selling	Yes	75	56,81	4260,50	614,500	,002
	No	27	36,76	992,50		
	Total	102				
IP or tech-in licensing or acquisition	Yes	75	52,99	3974,00	901,000	,379
	No	27	47,37	1279,00		
	Total	102				
Innovation network	Yes	75	53,21	3991,00	884,000	,292
	No	27	46,74	1262,00		
	Total	102				
Innovation intermediaries	Yes	75	54,13	4059,50	815,500	,110
	No	27	44,20	1193,50		
	Total	102				
Collaboration	Yes	75	54,59	4094,50	780,500	,059
	No	27	42,91	1158,50		
	Total	102				
Customer immersion	Yes	75	55,00	4125,00	750,000	,026
	No	27	41,78	1128,00		
	Total	102				
Lead users	Yes	75	56,70	4252,50	622,500	,001
	No	27	37,06	1000,50		
	Total	102				
Platforming	Yes	75	54,52	4089,00	786,000	,072
	No	27	43,11	1164,00		
	Total	102				

H_{741}: There is a statistically significant difference in rewarding individuals, groups or companies to provide ideas in the form of a competition or challenge with respect to level of process innovation.

H_{742}: There is a statistically significant difference in licensing or selling company's own patents and technology to other organizations with respect to level of process innovation.

H_{743}: There is a statistically significant difference in licensing or buying patents and technology with respect to level of process innovation.

H_{744}: There is a statistically significant difference in being part of an innovation network with respect to level of process innovation.

H_{745}: There is a statistically significant difference in getting help from an innovation intermediary with respect to level of process innovation.

H_{746}: There is a statistically significant difference in developing new products through collaborating with customers, suppliers, or other 3^{rd} party partners with respect to level of process innovation.

H_{747}: There is a statistically significant difference in observing customer-product interaction process to enhance good or services with respect to level of process innovation.

H_{748}: There is a statistically significant difference in identifying innovations added to company's own product by users and then incorporating these ideas back into products with respect to level of process innovation.

H_{749}: There is a statistically significant difference in providing a platform that customers can extend the capabilities of the products with respect to level of process innovation.

In order to test hypotheses Mann-Whitney U Test has been preferred. Because the variables are not normally distributed and there are only two groups. Groups are process innovations that are new to market and other (process innovations that are only new to the firm and companies that have not made a process innovation during the last three years). Table 8.68 shows Mann-Whitney U Test results regarding degree of process innovation and open innovation practices.

Test statistics show that there is not a statistically significant difference in idea competitions or challenges, innovation network, innovation intermediaries, collaboration, customer immersion, lead users with respect to level of process innovation. Hypotheses H_{741}, H_{744}, H_{745}, H_{746}, H_{747}, H_{748} have been rejected ($p>0.05$).

Table 8.68 : Mann-Whitney U test results for open innovation practices and degree of process innovation.

	New to Market Process Innovation	**N**	**Mean Rank**	**Sum of Ranks**	**U**	**p**
Idea competition/challenges	Yes	67	53,07	3556,00	1067,000	,433
	No	35	48,49	1697,00		
	Total	102				
IP or tech-out licensing or selling	Yes	67	58,19	3898,50	724,500	**,001**
	No	35	38,70	1354,50		
	Total	102				
IP or tech-in licensing or acquisition	Yes	67	57,04	3822,00	801,000	**,006**
	No	35	40,89	1431,00		
	Total	102				
Innovation network	Yes	67	54,06	3622,00	1001,000	,191
	No	35	46,60	1631,00		
	Total	102				
Innovation intermediaries	Yes	67	54,79	3671,00	952,000	,097
	No	35	45,20	1582,00		
	Total	102				
Collaboration	Yes	67	50,63	3392,50	1114,500	,661
	No	35	53,16	1860,50		
	Total	102				
Customer immersion	Yes	67	52,66	3528,00	1095,000	,541
	No	35	49,29	1725,00		
	Total	102				
Lead users	Yes	67	52,86	3541,50	1081,500	,486
	No	35	48,90	1711,50		
	Total	102				
Platforming	Yes	67	56,28	3771,00	852,000	,018
	No	35	42,34	1482,00		
	Total	102				

Hypotheses H_{742} and H_{743} has been accepted at 0.01 significance level. In that case, there is a statistically significant difference in licensing or selling company's own patents and technology to other organizations with respect to level of process innovation and this difference militates in favor of companies that have made a process innovation new to market during the last three years (mean rank=58.19). Also, there is a statistically significant difference in licensing or buying patents and technology with respect to level of process innovation and this difference militates in favor of companies that have a process innovation that is new to market (mean rank=57.04). Additionally H_{749} has been accepted ($p<0.05$). In that case, there is a

statistically significant difference in providing a platform that customers can extend the capabilities of the products in favor of companies that have made process innovation that is new to market (mean rank=56.28) and against other companies (mean rank=42.39).

8.4.1.8 Duration of practicing open innovation

H_{811}: There is a statistically significant difference in rewarding individuals, groups or companies to provide ideas in the form of a competition or challenge with respect to duration of practicing open innovation.

H_{812}: There is a statistically significant difference in licensing or selling company's own patents and technology to other organizations with respect to duration of practicing open innovation.

H_{813}: There is a statistically significant difference in licensing or buying patents and technology with respect to duration of practicing open innovation.

H_{814}: There is a statistically significant difference in being part of an innovation network with respect to duration of practicing open innovation.

H_{815}: There is a statistically significant difference in getting help from an innovation intermediary with respect to duration of practicing open innovation.

H_{816}: There is a statistically significant difference in developing new products through collaborating with customers, suppliers, or other 3^{rd} party partners with respect to duration of practicing open innovation.

H_{817}: There is a statistically significant difference in observing customer-product interaction process to enhance good or services with respect to duration of practicing open innovation.

H_{818}: There is a statistically significant difference in identifying innovations added to company's own product by users and then incorporating these ideas back into products with respect to duration of practicing open innovation.

H_{819}: There is a statistically significant difference in providing a platform that customers can extend the capabilities of the products with respect to duration of practicing open innovation.

Kruskal-Wallis Test has been performed to test hypotheses. Because variables are not normally distributed and there are more than two groups of duration of practicing open innovation (less than 1 year, 1-3 years, and more than 3 years). Due to the fact that, the data is low in the groups 3-5 years, 5-10 years, and more than 10 years, these groups has been united under more than 3 years as a single group. Table 8.69 shows statistics of Kruskal-Wallis Test results regarding duration of practicing open innovation and open innovation practices.

Table 8.69 : Kruskal-Wallis test results for open innovation practices and duration of practicing open innovation.

Open innovation Practices	Chi-Square	Df	Asymp. Sig.
Idea competitions/challenges	3,637	2	,162
IP or tech-out licensing or selling	2,008	2	,366
IP or tech-in licensing or acquisition	1,940	2	,379
Innovation network	1,209	2	,546
Innovation intermediaries	3,049	2	,218
Collaboration	5,021	2	,081
Customer immersion	12,674	2	,002
Lead users	6,027	2	,049
Platforming	2,436	2	,296

Except H_{817} and H_{818}, all hypotheses have been rejected ($p>0.05$). In that case, there is not a statistically significant difference in related open innovation practices with respect to duration of implementing open innovation. On the other hand, H_{817} has been accepted ($p<0.01$) and there is a significant difference in observing customer-product interaction process to enhance good or services with respect to duration of practicing open innovation (see table 8.70). This difference in implementing customer immersion militates in favor of companies that have been practicing open innovation between 1 and 3 years (mean rank=52.11) and more than 3 years (mean rank=60.09) in comparison with companies that have been practicing open innovation less than 1 year (mean rank=38.50). It is clear that, companies does not prefer to observe customer-product innovation if they have been using open innovation less than 1 year as much as other companies that have been using open innovation more than 1 year. Additionally, H_{818} has been accepted ($p<0.05$) and there is a significant difference in identifying innovations added to company's own

product by users and then incorporating these ideas back into products with respect to duration of practicing open innovation. This difference regarding lead users militates in favor of companies that have been practicing open innovation more than 3 years (mean rank=57.85) and against companies that have been practicing open innovation less than 1 year (mean rank=42.08).

Table 8.70 : Mann-Whitney U test results for open innovation practices and duration of practicing open innovation.

Customer Immersion			**Lead Users**		
Mean Rank	**U**	**p**	**Mean Rank**	**U**	**p**
1-3 years$_{(52,11)}$ > Less than 1 year$_{(38,50)}$	438,500	,030	More than 3 years$_{(57,85)}$ > Less than 1 year$_{(42,08)}$	350,000	,017
More than 3 years$_{(60,09)}$ > Less than 1 year$_{(38,50)}$	283,5000	,001			

H_{821}: There is a statistically significant difference in importance level of accelerating time to complete R&D as a motivation factor during the use of open innovation with respect to duration of practicing open innovation.

H_{822}: There is a statistically significant difference in importance level of minimizing risk of innovation projects as a motivation factor during the use of open innovation with respect to duration of practicing open innovation.

H_{823}: There is a statistically significant difference in importance level of reducing R&D costs per project as a motivation factor during the use of open innovation with respect to duration of practicing open innovation.

H_{824}: There is a statistically significant difference in importance level of exploring new technological trends as a motivation factor during the use of open innovation with respect to duration of practicing open innovation.

H_{825}: There is a statistically significant difference in importance level of identifying new business opportunities as a motivation factor during the use of open innovation with respect to duration of practicing open innovation.

H_{826}: There is a statistically significant difference in importance level of establishing new partnerships as a motivation factor during the use of open innovation with respect to duration of practicing open innovation.

To test hypotheses, Kruskal-Wallis Test has been carried out because of the fact that variables are not normally distributed and there are more than two groups of duration of practicing open innovation (less than 1 year, 1-3 years, more than 3 years). Table 8.71 shows statistics of Kruskal-Wallis Test regarding duration of practicing open innovation and motives to open innovation.

Table 8.71 : Kruskal-Wallis test results for motives to open innovation and duration of practicing open innovation.

Motives to Open Innovation	Chi-Square	Df	Asymp. Sig.
Accelerating time to complete R&D	5,125	2	,077
Minimizing risk of innovation projects	3,303	2	,192
Reducing R&D costs per project	3,940	2	,139
Exploring new technological trends	3,950	2	,139
Identifying new business opportunities	4,890	2	,087
Establishing new partnerships	4,301	2	,116

All hypotheses H_{821}, H_{822}, H_{823}, H_{824}, H_{825}, and H_{826} have been rejected ($p>0.05$). In that case, there is not a statistically significant difference in any motivation factors to open innovation with respect to duration of implementing open innovation.

H_{831}: There is a statistically significant difference in frequencies of encountering constraints regarding confidentiality and conservativeness during the use of open innovation with respect to duration of practicing open innovation.

H_{832}: There is a statistically significant difference in frequencies of encountering constraints regarding human resources, brand and image during the use of open innovation with respect to duration of practicing open innovation.

H_{833}: There is a statistically significant difference in frequencies of encountering constraints regarding resources and costs during the use of open innovation with respect to duration of practicing open innovation.

H_{834}: There is a statistically significant difference in frequencies of encountering constraints regarding management and organization during the use of open innovation with respect to duration of practicing open innovation.

H_{835}: There is a statistically significant difference in frequencies of encountering constraints regarding market, partnership and technology sources during the use of open innovation with respect to duration of practicing open innovation.

H_{836}: There is a statistically significant difference in frequencies of encountering administrative constraints during the use of open innovation with respect to duration of practicing open innovation.

Due to the fact that variables are normally distributed and there are more than two groups of duration of practicing open innovation (less than 1 year, 1-3 years, more than 3 years), ANOVA has been performed. Table 8.72 shows statistics of ANOVA for all hypotheses regarding duration of practicing open innovation and frequencies of encounter constraints on open innovation.

Table 8.72 : ANOVA test results for constraints on open innovation and duration of practicing open innovation.

		Sum of Squares	**Df**	**Mean Square**	**F**	**Sig.**
Confidentiality, conservativeness	Between Groups	1,981	2	,991	1,204	,305
	Within Groups	77,345	94	,823		
	Total	79,326	96			
Human resources, brand and image	Between Groups	2,402	2	1,201	1,397	,252
	Within Groups	80,811	94	,860		
	Total	83,213	96			
Resources and costs	Between Groups	,232	2	,116	,134	,875
	Within Groups	81,309	94	,865		
	Total	81,541	96			
Management and organization	Between Groups	,394	2	,197	,247	,782
	Within Groups	75,061	94	,799		
	Total	75,455	96			
Market, partnership and technology sources	Between Groups	1,227	2	,614	,716	,491
	Within Groups	80,509	94	,856		
	Total	81,737	96			
Administrative	Between Groups	5,826	2	2,913	2,516	,086
	Within Groups	108,859	94	1,158		
	Total	114,686	96			

All hypotheses H_{831}, H_{832}, H_{833}, H_{834}, H_{835}, and H_{836} have been rejected because of the fact that p-values are greater than 0.05 (0.305, 0.252, 0.875, 0.782, 0.491, and 0.086 respectively). Therefore, there is not a statistically significant difference in

frequencies of encountering any constraints on open innovation with respect to duration of practicing open innovation. It can be said that duration of practicing open innovation does not affect frequency of constraints regarding open innovation.

H_{841}: There is a statistically significant difference in importance level of increasing the working hours as an action to compensate the constraints with respect to duration of practicing open innovation.

H_{842}: There is a statistically significant difference in importance level of increasing product differentiation as an action to compensate the constraints with respect to practicing open innovation.

H_{843}: There is a statistically significant difference in importance level of looking for different markets as an action to compensate the constraints with respect to practicing open innovation.

H_{844}: There is a statistically significant difference in importance level of reducing prices of products as an action to compensate the constraints with respect to practicing open innovation.

H_{845}: There is a statistically significant difference in importance level of improving quality of products as an action to compensate the constraints with respect to practicing open innovation.

H_{846}: There is a statistically significant difference in importance level of looking for market niches as an action to compensate the constraints with respect to practicing open innovation.

H_{847}: There is a statistically significant difference in importance level of improving marketing activities as an action to compensate the constraints with respect to practicing open innovation.

H_{848}: There is a statistically significant difference in importance level of forming strategic partnerships as an action to compensate the constraints with respect to practicing open innovation.

H_{849}: There is a statistically significant difference in importance level of reducing production as an action to compensate the constraints with respect to practicing open innovation.

H_{8410}: There is a statistically significant difference in importance level of reducing production costs as an action to compensate the constraints with respect to practicing open innovation.

To test hypotheses, Kruskal-Wallis Test has been used. Because variables are not normally distributed and there are more than two groups of duration of practicing open innovation (less than 1 year, 1-3 years, more than 3 years). Table 8.73 shows statistics of Kruskal-Wallis Test results regarding duration of practicing open innovation and importance level of actions to compensate barriers on competition.

Table 8.73 : Kruskal-Wallis test results for actions to compensate barriers on competition and duration of practicing open innovation.

Actions	Chi-Square	Df	Asymp. Sig.
Increasing the working hours	,026	2	,987
Increasing product differentiation	1,676	2	,433
Looking for different markets	4,264	2	,119
Reducing prices of goods/services	,313	2	,855
Improving quality of goods/services	2,511	2	,285
Looking for market niches	3,198	2	,202
Improving marketing activities	5,359	2	,069
Forming strategic partnerships	2,266	2	,322
Reducing production	5,426	2	,066
Reducing production costs	3,188	2	,203

All p-values are greater than 0.05. Therefore, H_{841}, H_{842}, H_{843}, H_{844}, H_{845}, H_{846}, H_{847}, H_{848}, H_{849}, and H_{8410} have been rejected. There is not a statistically significant difference in importance level of actions to compensate barriers on competition with respect to duration of practicing open innovation.

H_{851}: There is a statistically significant difference in importance level of employees as a collaborating partner during the development of innovation with respect to duration of practicing open innovation.

H_{852}: There is a statistically significant difference in importance level of consultants as a collaborating partner during the development of innovation with respect to duration of practicing open innovation.

H_{853}: There is a statistically significant difference in importance level of support and incentive funds as a collaborating partner during the development of innovation with respect to duration of practicing open innovation.

H_{854}: There is a statistically significant difference in importance level of development agencies as a collaborating partner during the development of innovation with respect to duration of practicing open innovation.

H_{855}: There is a statistically significant difference in importance level of customers as a collaborating partner during the development of innovation with respect to duration of practicing open innovation.

H_{856}: There is a statistically significant difference in importance level of competitor companies as a collaborating partner during the development of innovation with respect to duration of practicing open innovation.

H_{857}: There is a statistically significant difference in importance level of suppliers and stakeholders as a collaborating partner during the development of innovation with respect to duration of practicing open innovation.

H_{858}: There is a statistically significant difference in importance level of technology transfer offices as a collaborating partner during the development of innovation with respect to duration of practicing open innovation.

H_{859}: There is a statistically significant difference in importance level of universities and other academic institutions as a collaborating partner during the development of innovation with respect to duration of practicing open innovation.

Due to the fact that variables are not normally distributed and there are more than two groups of duration of practicing open innovation (less than 1 year, 1-3 years, more than 3 years), Kruskal-Wallis Test has been used. Table 8.74 shows statistics of Kruskal-Wallis Test results regarding duration of practicing open innovation and importance levels of collaborating partners during the development of innovation.

All hypotheses H_{851}, H_{852}, H_{853}, H_{854}, H_{855}, H_{856}, H_{857}, H_{858}, and H_{859} have been rejected ($p>0.05$). There is not a statistically significant difference in importance levels of any collaborating partners during the use of innovation with respect to duration of practicing open innovation.

Table 8.74 : Kruskal-Wallis test results for collaborating partner and duration of practicing open innovation.

Collaborating Partners	Chi-Square	Df	Asymp. Sig.
Employees	,020	2	,990
Consultants	1,109	2	,574
Support and incentive funds	5,215	2	,074
Development agencies	2,695	2	,260
Customers	4,671	2	,097
Competitor Companies	2,691	2	,260
Suppliers/stakeholders	2,128	2	,345
Technology transfer offices	1,389	2	,499
Universities and other academic institutions	1,564	2	,458

8.4.1.9 Investment on products that fall under open innovation category

H_{911}: There is a statistically significant difference in rewarding individuals, groups or companies to provide ideas in the form of a competition or challenge with respect to rate of investment on open innovation.

H_{912}: There is a statistically significant difference in licensing or selling company's own patents and technology to other organizations with respect to rate of investment on open innovation.

H_{913}: There is a statistically significant difference in licensing or buying patents and technology with respect to rate of investment on open innovation.

H_{914}: There is a statistically significant difference in being part of an innovation network with respect to rate of investment on open innovation.

H_{915}: There is a statistically significant difference in getting help from an innovation intermediary with respect to rate of investment on open innovation.

H_{916}: There is a statistically significant difference in developing new products through collaborating with customers, suppliers, or other 3^{rd} party partners with respect to rate of investment on open innovation.

H_{917}: There is a statistically significant difference in observing customer-product interaction process to enhance good or services with respect to rate of investment on open innovation.

H_{918}: There is a statistically significant difference in identifying innovations added to company's own product by users and then incorporating these ideas back into products with respect to rate of investment on open innovation.

H_{919}: There is a statistically significant difference in providing a platform that customers can extend the capabilities of the products with respect to rate of investment on open innovation.

Kruskal-Wallis Test has been performed because of the fact that variables are not normally distributed and there are more than two groups of rate of investment on open innovation (less than 5%, 5%-20%, more than 20%). Table 8.75 shows statistics of Kruskal-Wallis Test regarding rate of investment and open innovation practices.

Table 8.75 : Kruskal-Wallis test results for open innovation practices and investment on open innovation.

Open innovation Practices	Chi-Square	Df	Asymp. Sig.
Idea competitions/challenges	1,245	2	,537
IP or tech-out licensing or selling	1,265	2	,531
IP or tech-in licensing or acquisition	3,543	2	,170
Innovation network	5,391	2	,068
Innovation intermediaries	1,548	2	,461
Collaboration	5,796	2	,055
Customer immersion	10,864	2	,004
Lead users	2,527	2	,283
Platforming	1,166	2	,558

H_{911}, H_{912}, H_{913}, H_{914}, H_{915}, H_{916}, H_{918}, and H_{919} have been rejected ($p>0.05$). Only H_{917} has been accepted ($p<0.01$). There is a statistically significant difference in observing customer-product interaction process to enhance good or services with respect to rate of investment on open innovation. To understand which groups are different from each other, Mann-Whitney U Test has been carried out (see Table 8.76). According to Mann-Whitney U Test statistics, difference militates in favor of companies that invested more than 20% of all investment for innovative products that fall under the open innovation category (mean rank=58.68) in comparison with companies that invested less than 5% of all investment (mean rank=38.03).

Table 8.76 : Mann-Whitney U test results for open innovation practices and investment on open innovation.

Mean Rank	U	p
More than $20\%_{(58,68)}$ > Less than $5\%_{(38,03)}$	285,500	,001

8.4.1.10 Position in the organization

H_{10}: There is a statistically significant difference in level of being knowledgeable with open innovation with respect to position in the organization.

To test H_{10}, Kruskal-Wallis Test has been used. Because variables are not normally distributed and there are more than two groups (company owner, manager, specialist/engineer, administrative/support staff). Table 8.77 shows test statistics.

Table 8.77 : Kruskal-Wallis test result for being knowledgeable with open innovation and position in the organization.

I am knowledgeable on the topic of Open Innovation	
Chi-Square	,642
Df	3
Asymp. Sig.	,887

H_{10} has been rejected ($p>0.05$). In that case, there is not a statistically significant difference in being knowledgeable with open innovation depending on position in the organization.

8.4.2 Correlation Analysis

In order to measure the strength of association between variables, correlation analysis has been carried out. When variables are normally distributed, Pearson correlation coefficient has been preferred. Otherwise, Spearman rank correlation has been used because of the fact that it does not assume any assumptions about the distribution of data.

H_{11}: There is a significant correlation between being knowledgeable with open innovation of all organization with open innovation and management support.

Table 8.78 shows results of correlation analysis regarding management support to open innovation and knowledge of organization about open innovation. According to results of correlation analysis, correlation is significant at the 0.01 level and H_{11} has been accepted. There is a low positive correlation between management support to open innovation and being knowledgeable with open innovation of all organization because of the fact that Spearman correlation coefficient is 0.373.

Table 8.78 : Correlation analysis results for management support and being knowledgeable with open innovation of all organization.

Correlations				
			Management Support	Org. Knowledge
Spearman's rho	Management Support	Correlation Coefficient	1,000	,373**
		Sig. (2-tailed)	.	,000
		N	97	97
	Org. Knowledge	Correlation Coefficient	,373**	1,000
		Sig. (2-tailed)	,000	.
		N	97	102

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

H_{12}: There is a significant correlation between being knowledgeable with open innovation of all organization and intensity of practicing open innovation.

Table 8.79 shows results of correlation analysis regarding knowledge of organization about open innovation and intensity of using open innovation

Table 8.79 : Correlation analysis results for being knowledgeable with open innovation of all organization and intensity of using open innovation.

Correlations				
			Knowledge of org.	Implementing OI intensily
Spearman's rho	Knowledge of org.	Correlation Coefficient	1,000	,357**
		Sig. (2-tailed)	.	,000
		N	102	97
	Implementing OI intensily	Correlation Coefficient	,357**	1,000
		Sig. (2-tailed)	,000	.
		N	97	97

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

H_{12} has been accepted and correlation is significant at the 0.01 level. There is a low positive correlation between being knowledgeable with open innovation of all organization and intensity of open innovation implementation.

H_{13}: There is a significant correlation between being sensitive to the protection of intellectual property rights and practicing open innovation.

H_{13} has been accepted and correlation is significant at the 0.05 level (see Table 8.80). On the other hand, there is a negligible correlation between being sensitive to protection of intellectual property rights and practicing open innovation. It can be

said that being sensitive to protection of intellectual property right does not relate to all open innovation practices.

Table 8.80 : Correlation analysis results for practicing open innovation and sensitivity of IPR.

Correlations				
			Practicing Open Innovation	Sensitivity to IPR
Spearman's rho	Practicing Open Innovation	Correlation Coefficient	1,000	,242*
		Sig. (2-tailed)	.	,014
		N	102	102
	Sensitivity to IPR	Correlation Coefficient	,242*	1,000
		Sig. (2-tailed)	,014	.
		N	102	102

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

H_{14}: There is a significant correlation between implementing open innovation more intensely and management support to open innovation.

Table 8.81 shows the results of correlation analysis regarding practicing open innovation more intensely and management support to open innovation. H_{14} has been accepted and correlation is significant at the 0.01 level. In that case, there is a low positive correlation between implementing open innovation more intensely and management support to open innovation due to the fact that correlation coefficient is 0.482.

Table 8.81: Correlation analysis results for implementing open innovation more intensely and management support to open innovation.

Correlations				
			Implementing OI more intensely	Management Support to OI
Spearman's rho	Implementing OI more intensely	Correlation Coefficient	1,000	,482**
		Sig. (2-tailed)	.	,000
		N	97	97
	Management Support to OI	Correlation Coefficient	,482**	1,000
		Sig. (2-tailed)	,000	.
		N	97	97

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

H_{15}: There is a significant correlation between management support to open innovation and rate of investment on products that fall under open innovation category.

Table 8.82 shows results of correlation analysis regarding management support to open innovation and investment on products that fall under open innovation category. H_{15} has been rejected because of the fact that correlation is not significant. Therefore, rate of investment in open innovation does not correlate with support from management.

Table 8.82 : Correlation analysis results for management support to open innovation and investment on open innovation.

Correlations				
			Management Support to OI	Investment Rate
Spearman's rho	Management Support to OI	Correlation Coefficient	1,000	,194
		Sig. (2-tailed)	.	,057
		N	97	97
	Investment Rate	Correlation Coefficient	,194	1,000
		Sig. (2-tailed)	,057	.
		N	97	97

H_{16}: There is a significant correlation between rate of investment on products that fall under open innovation category and turnover rate or sales revenue from them.

H_{16} has been accepted and correlation is significant at the 0.01 level (see Table 8.83). There is a moderate positive correlation between investment on products that fall under open innovation category and turnover from these products.

Table 8.83 : Correlation analysis results for inversment on open innovation and turnover from open innovation.

Correlations				
			Investment Rate	Turnover Rate
Spearman's rho	Investment Rate	Correlation Coefficient	1,000	,593**
		Sig. (2-tailed)	.	,000
		N	97	97
	Turnover Rate	Correlation Coefficient	,593**	1,000
		Sig. (2-tailed)	,000	.
		N	97	97

9. SUMMARY OF FINDINGS, DISCUSSION, CONCLUSION, POLICY RECOMMENDATIONS, LIMITATIONS AND FURTHER RESEARCH

It is a disputable fact that making innovation is the sole remedy in order to survive and perform sustainably in today's global competitive environment. For many years companies have managed to be innovative by using only their own R&D resources. However, making innovation through using firms' own limited internal resources puts firms behind the eight ball in today's world due to the fact that environmental conditions tend to evolve day by day. It can be said that this traditional approach based on innovation activities that are carried out with the objective of obtaining the highest profit has become obsolete. In that case, an innovation is also needed in the way of making innovation. Today's market conditions and developments in technology encourage companies to practice open innovation that is known as the use of purposive inflows and outflows of technology and knowledge with the intention of quickening firms' own internal innovation, and enlarging the markets through external use of innovation, respectively.

Science parks are natural providers of open innovation as multifaceted connectors across start-ups, small and medium sized enterprises, large companies, universities, and research laboratories due to their collaboration and networking characteristics. Unfortunately, some small companies in science parks tend to stay in their own collaboration networks and keep their innovation systems closed in order to protect themselves from larger companies and therefore they cannot benefit from advantages of open innovation. Especially, technology-intensive start-ups and SMEs are in great need of external technologies and knowledge to make innovations. On the other hand, most of the studies in the open innovation literature focus on large and multinational companies (MNCs) in comparison with smaller ones.

By taking all these situations into consideration, in this thesis study, status of open innovation has been researched and mostly focused on technology-intensive SMEsthat operate in science parks in Turkey. Also, innovativeness levels of companies, motivation factors to open innovation, constraints on open innovation, actions to compensate barriers on competition have been stated. Before stating status of open innovation in technology-intensive SMEs that operate in science parks, innovativeness levels of these firms have been researched.

9.1 Summary of Findings and Discussion

All findings of this thesis study are discussed in this section as a summary.

- Product and process innovation

85% of companies have made both process and product innovation during the last three years and remained companies has made only product innovation or only process innovation except one company. By taking types of product innovation into consideration, most of the companies have introduced both new or significantly improved goods and services in the last three years. On the other hand, most of the companies have introduced only new or significantly improved methods of manufacturing or producing methods in comparison with other types of process innovation. Companies that operate in science parks in Turkey prefer make their innovations on their own and it is followed by making innovations together with other enterprises or institutions. It can be said that these enterprises are in a transitional period from closed innovation approach to open innovation approach. Additionally, in the last three years both product and process innovations that made by technology-intensive companies in science parks are new to their market. In that case, technology-intensive companies are very innovative in order to keep up with the times.

- Open innovation awareness and management support to open innovation

Respondents that are from executive level such as company owner, manager, specialist, and administrative staff are knowledgeable with open innovation. Also, the same trend continues about knowledge of whole organization on open innovation. In that case, technology-intensive companies that operate in science parks are not stranger to open innovation.

A high majority of SMEs has been practicing open innovation and most of them have been practicing it less than three years. Also, SMEs are implementing open innovation more intensely and management support for open innovation is increasing, compared the three years ago. This evidence suggests that open innovation is not a whim that will be gone soon. Results of this study are in line with the studies of Lichtenthaler (2008) who showed that medium-sized and large companies embrace on open innovation and van de Vrande and others (2009) who showed that small and medium-sized enterprises embrace on open innovation, and Chesbrough and Brunswicker (2013) who showed the same results for only large companies.

- Importance of collaborating partners

The most important collaborating partners during the development of innovation are employees and customers respectively and the least important collaborating partners are development agencies for science park firms. It can be argued that tendency to closed approach continues considering the great importance of employees as collaborating partners. But also employee involvement that means capitalizing on the knowledge of company's employees even if they are not the employees of internal R&D department is one of the technology exploitation practices. On the other side, importance given to customers as collaborating partners shows the importance given to technology exploration through counting customers in innovation process directly due to the fact that customers are one of the external sources of useful knowledge and customer involvement is the major constituent of open innovation.

- Open innovation practices

The most preferred open innovation practices are customer immersion, collaboration, and lead users respectively. Once again, the importance given to customers is distinguishable. In other respects, idea competitions are the least preferred open innovation activities. This indicates an opportunity for companies to explore this method of open innovation in Turkey. Another salient finding is that inward and outward IP licensing are not preferred open innovation practices by science park firms in comparison with customer immersion, collaboration, lead users and platforming. It can be said that the most preferred practices by technology-intensive companies that operate in science parks such as customer immersion and

collaboration are unstructured and informal practices and they do not require significant investments. Contrariwise, less used practices such as inward IP licensing and outward IP licensing are structured and formal practices and require substantial investments. These findings confirm the results of the study of van de Vrande and others (2009).

- Motivation factors to practice open innovation

It is found that the most important motivation factors to practice open innovation are exploring new technological trends, accelerating time to complete R&D, and identifying new business opportunities, respectively. Chesbrough (2003a) argues that firms apply open innovation in innovation process in order to adapt changing environment and track trends. This means that the results are in line with this argument of Chesbrough (2003a). However, establishing new partnerships is the least important motivation factor to engage in open innovation for technology-intensive companies although it is found as the most important strategic objective for large companies in the study of Chesbrough and Brunswicker (2013). Because of the fact that establishing new partnerships requires formalized contracts, a structured innovation portfolio approach for risk management and substantial investments, large companies use this open innovation practice more than smaller ones and this finding is not surprising.

- Constraints on open innovation

The most common constraints on open innovation that are encountered by science park firms are administrative constraints that comprise problems related to administration and finance, constraints regarding resources and costs, and constraints regarding management and organization, respectively. According to Gruber and Henkel (2006), small companies face challenges such as having very limited financial resources due to their smallness and challenges such as unknown organizational entity, lack of trust in the abilities and offering, reliance on social interaction among strangers, lack of exchange relationship due to their newness. Small firms cannot resist unfavorable business conditions and they can suffer from even minor inefficiencies owing to lack of financial resources (Gruber and Henkel, 2006). In addition, Narula (2004) argues that SMEs are constrained by their limited resources because of their smallness. On the other side, most of the participating

companies were founded after 2010 and they are in disadvantageous position compared to mature firms. It can be argued that the most frequent constraints encountered by technology-intensive companies, which are mostly small and medium-sized enterprises in this study, regarding open innovation are caused by smallness and newness of them. Additionally, van de Vrande and others (2009) suggest that the most important constraints to open innovation result from causes like cultural and organizational problems and these problems arise often when small and medium-sized enterprises interact with external partners. Constraints regarding human resource, brand and image are the least frequently encountered constraints by technology-intensive companies that operate in science parks in Turkey. Findings of this thesis study regarding constraints on open innovation are in line with findings of mentioned studies. Moreover, all constraints on open innovation are positively correlated with each other.

- Actions to compensate barriers on competition

For technology-intensive companies that operate in science parks in Turkey, the most important actions to compensate barriers on competition are improving quality of goods and services, improving marketing activities, and forming strategic partnerships, respectively and the least important actions are reducing production and increasing working hours, respectively.

- Investment on and turnover from products that fall under open innovation category

Investment patterns and turnover or annual sale of science park companies regarding products that fall under open innovation category are very diverse. In the last three years, 32% of these companies have invested more than 20% of their total investments on products that fall under open innovation category. On the other hand, 35% of science park companies have invested less than 10% of their total investments and 18% of them made no investment on products that fall under open innovation category. In addition, 23.5% of all firms got more than 20% of their all annual turnover from innovative products, which fall under open innovation category in the last three years.

- Sensitivity to protection of intellectual propert rights

As it is expected, science park companies that are mostly small and medium-sized companies are very sensitive to protection of intellectual property rights. Protection of intellectual property is essential to SMEs because of the fact that they have to protect their intellectual property rights from larger companies. In addition, SMEs should protect their intellectual property rights if they want to have market power to capture value of externally sourced knowledge. However, ability to protect intellectual property may be limited for SMEs in the cause of their economic dependence on large companies (Chesbrough, 2010).

- Differences by age of the company

Whether there is a significant difference in the use of open innovation practices, motives to open innovation, constraints on open innovation, actions to compensate barriers on competition, and collaborating partners during the development of innovation with respect to age of the company has been stated owing to the fact that age variable is related to experience of the company.

There is not a significant difference in practicing open innovation between age groups. Studies on this subject vary. Keupp and Gasmann (2009) and Schroll and Mild (2011) suggest that age is not a predictor of using open innovation and degree of openness. On the other hand, Idrissia and others (2012) argue that the older the company, the higher the probability of practicing open innovation.

There is a statistically difference in significance level of exploring new technological trends that is found as the most important motivation factor for technology-intensive companies that operate in science parks in favor of companies that have been operating more than 5 years in comparison with companies that have been operating less than 5 years. In that case, older science park companies give more importance to explore technological trends in order to move with the times.

There is not a significant difference in frequencies of facing constraints on open innovation in terms of age of the company.

By taking actions to compensate barriers on competition into consideration, importance of looking for different markets differs in favor of companies that have been operating more than 5 years. It is clear that younger firms do not consider looking for different markets as an important action to compensate barriers on

competition before gaining experience. Also, importance of reducing production that is considered as the least important action to compensate barriers on competition by participating companies differs in favor of companies, which have been operating less than 5 years. Here again the importance of experience is conspicuous.

In addition, whether importance levels of collaborating partners differ from each other in terms of age of the company and customers are more important for science park companies that have been operating more than 5 years.

It can be argued that age is important for the company to adopt open innovation practices due to the fact that it provides firms with experience required to build bridges with customers and external partners, and have strong strategies.

- Differences by geographical area that is operated in

Differences have been tested with respect to geographical area that the company operates in. Open innovation practices, frequencies of encountering constraints on open innovation, and importance levels of actions to compensate barriers on competition do not vary by geographical region.

Importance of minimizing risk of R&D projects as a motivation factor to open innovation differ against Mediterranean Region in comparison with other all geographical regions of Turkey. It can be said that companies that operate in Mediterranean Region do not consider minimizing risk of R&D projects as an important motive to open innovation unlike other companies.

Furthermore, firms that operate in Marmara, Central Anatolia, and Eastern Anatolia Regions give more importance to competitor companies as a collaborating partner than companies that operate in Black Sea Region and companies that operate in Central Anatolia and Eastern Anatolia Regions give more importance to competitor companies as a collaborating partner than companies that operate in Mediterranean Region. In addition, companies that operate in Mediterranean and Central Anatolia Regions give more importance to development agencies as a collaborating partner than companies that operate in Marmara Region.

- Differences by target market

It is clear that a firm operating within national boundaries considers only internal or domestic competition. On the other hand, there are always cultural problems and

barriers for companies that target international or external markets. Because, competition in external markets is more complex, dynamic and difficult than competition in domestic markets. There are differences between internal and external market with respect to consumer needs, wants, and usage patterns for products. Also, companies that target external market must concern about legal terms and conditions of foreign countries that they operate in. And what is worse, degree of technology may vary by country. Because of all these reasons, companies have been divided into two groups as companies targeting only internal market and companies targeting both internal and external market and whether there is a significant difference in the use of open innovation practices, motives to open innovation, constraints on open innovation, actions to compensate barriers on competition, and collaborating partners during the development of innovation with respect to target market has been stated.

Considering open innovation practices, there is a statistically significant difference in being part of an innovation network in favor of companies of which target market is both internal and external. Knowledge gaps can be filled swiftly without the need for spending a lot of money and time thanks to networks. Moreover, there is a statistically significant difference in collaboration with customers, suppliers, or other 3rd party partners on behalf of companies that target both internal and external market. Once again, identifying innovations added to company's own product by users and then incorporating these ideas back into products differs on behalf of companies that target both internal and external market. Lastly, platforming differs on behalf of companies of which target market is both internal and external. The results are not surprising. Open innovation practices such as innovation network, collaboration, lead users, and platforming are more crucial for SMEs that operate in both internal and external market and make it easier to understand needs and wants of customers and compete in a fierce competition environment, undoubtedly.

Considering motivation factors, establishing new partnerships differs in favor of companies that operate in both internal and external market. Establishing new partnerships provides great advantages such as complementary skills of partners, larger pool of capital, changing legal structures easily when circumstances change, little government regulation flexibility, tax advantages etc. (Zimmerer and others, 2008) and it is important for especially SMEs that operate in both domestic and international market.

There is not a significant difference in frequencies of encountering constraints on open innovation and importance levels of collaborating partners with respect to target market of the company. However, increasing the working hours as an action to compensate barriers on competition is more important for companies of which target market is both internal and external.

- Differences by type of the company

Differences between being an independent company and being the subsidiary of an international company have been also stated and it has been seen that practicing open innovation, importance levels of motivation factors to open innovation, and importance levels of collaborating partners do not vary by type of SMEs.

On the other side, frequency of encountering administrative problems that comprises problems regarding administration and finance differs on behalf of companies that are subsidiaries of an international company. Based on actions to compensate barriers on competition, looking for different markets is more important for companies, which are subsidiaries of international companies and increasing marketing activities is more important for independent companies. Firstly, subsidiary companies that are partly or wholly owned by a holding company have little or no financial control over their activities such as investment decisions, and budgeting. Additionally, holding companies maintain authority and direct operations and management of their subsidiaries. Maybe the biggest advantage of having or being a subsidiary company is that it gives the holding or subsidiary company an international recognition and presence. Then, findings seem quite reasonable.

- Differences by number of employees and annual turnover of the company

In Turkey, if enterprises have more than 250 employees and their annual turnover exceed 40 million TL, these enterprises are considered as large enterprises. On the other side, enterprises whose number of employees are between 50 and 250 and annual turnover is between 8 million TL and 40 million TL are considered as medium-sized enterprises, enterprises whose number of employees are between 10 and 50 and annual turnover is between 1 million TL and 8 million TL are considered as small-sized enterprises, and enterprises whose number of employees less than 10 and annual turnover is less than 1 million TL are considered as micro-scaled enterprises.

Whether there are differences in the use of open innovation practices, motives to open innovation, constraints on open innovation, actions to compensate barriers on competition, and collaborating partners during the development of innovation with respect to employee number and annual turnover of the participating companies have been stated. It has been concluded that there is no difference in practicing open innovation in terms of employee number and annual turnover. However, it was found that large companies practice open innovation more intensely and broadly than their smaller counterparts in some studies (Laursen and Salter, 2006; Keupp and Gassmann, 2009; Bianchi and others, 2011). Additionally, van de Vrande and others (2009) found significant difference in adopting and practicing open innovation in favor of medium-sized enterprises in comparison with small-sized enterprises.

Based on importance levels of motives to open innovation, there is a difference in importance level of accelerating time to complete R&D in favor of companies that have 100-250 employees and more than 250 employees and against companies that have 10-49 employees and there is a difference in importance level of exploring technological trends on behalf of companies of which annual turnover is between 8 million TL and 25 million TL in comparison with companies of which annual turnover is between 1 million TL and 8 million TL and less than 1 million TL. Then, it can be argued that medium-sized and large companies give more importance to accelerate time to complete R&D than small-sized companies and medium-sized companies give more importance to exploring technological trends more than small and micro-sized companies.

On the other hand, there is not a statistically significant difference in frequencies of encounter constraints on open innovation and importance levels of collaborating partners during the development of innovation with respect to employee number and annual turnover and there is not a significant difference in importance levels of actions to compensate barriers on competition with respect to employee number of the firm. However, there is a significant difference in importance level of looking for different markets as an action to compensate barriers on competition in favor of companies of which annual turnover is between 8 million TL and 25 million TL in comparison with companies of which annual turnover is less than 1 million TL.

- Differences by developers and degree of product and process innovation

Whether there are differences in the use of open innovation practices with respect to developers of both product and process innovation, degree of both product and process innovation have been stated.

Developers of innovations have been divided into two groups as enterprise by itself and other that comprises enterprise together with other enterprises or institutions, enterprise by adapting or modifying processes originally, and other enterprises or institutions. There is not a statistically significant difference in practicing open innovation depending on developers of product innovation. However, there is a significant difference in developing new products through collaborating with customers, suppliers, or other 3rd party partners in favor of enterprises who develop process innovations together with other enterprises or institutions, enterprises who develop process innovation by adapting or modifying processes of other enterprises or institutions, and enterprises that have other enterprises or institutions make process innovations. This result seems quite reasonable. Because it is not expected that companies, which develop their innovation on their own practice collaboration as an open innovation approach more than companies, which develop their innovations with other enterprises.

In addition, degree of innovation has been divided into two groups as new to market and other that comprises new-to-firm innovation and no innovation. There is a significant difference in using idea competitions or challenges in favor of companies that have introduced a new-to-market product innovation during the last three years. Furthermore, there is a statistically significant difference in outward IP licensing on behalf of companies that have made a product innovation new to market. Once again, observing customer-product interaction process to enhance good or services statistically differs in favor of companies that have made a product innovation new to market during the last three years. Finally, taking advantage of lead users as an open innovation approach differs on behalf of companies that have introduced product innovations to the market during the last three years. Then, customers and users are really important to make new-to-market product innovations and companies, which have made new-to-market product innovations, commercialize their internal ideas to external companies whose business models fit the innovation better and practice outward IP licensing more than other companies. Based on degree of process

innovation, there is a significant difference in both inward and outward IP licensing and providing a platform that customers can extend the capabilities of the products in favor of companies that have made a process innovation new to market during the last three years.

- Differences by duration of practicing open innovation

Duration of practicing open innovation has been considered as grouping variable and differences in practicing open innovation, importance levels of motives to open innovation, frequencies of facing challenges, importance levels of actions to compensate barriers on competition and importance levels of collaborating partners have been determined.

Practicing customer immersion as an open innovation approach vary by duration of using open innovation and this difference militates in favor of companies that have been practicing open innovation more than 1 year and against companies that have been practicing open innovation less than one year. Moreover, lead user as an open innovation approach is used much more by companies that have been using open innovation more than 3 years in comparison with companies, which have been practicing open innovation less than 1 year. In that case, new practitioners of open innovation do not prefer customer immersion and lead user methods as much as older practitioners prefer them.

In other respects, importance level of motivation factors, frequency of having difficulties in open innovation, importance level of activities for compensating difficulties in competition, and importance level of collaborating partners during the use of innovation do not differ in the matter of duration of practicing open innovation.

- Differences by rate of investment on products that fall under open innovation category

Rate of investment on open innovation has been considered as grouping variable and differences regarding this variable have been stated. The only open innovation practice that varies by rate of investment on open innovation is customer immersion that means observing customer-product interaction process to develop products. This difference militates in favor of companies that invested more than 20% of all investment on products that fall under open innovation category in comparison with

companies that invested less than 5% of all investment on products that fall under open innovation category in the last three years.

- Differences by position in the organization

Positions of respondents in the organization have been grouped as company owner, manager, specialist/engineer, and administrative/support staff. There is not a difference in being knowledgeable with open innovation with respect to position in the organization.

- Correlations

After difference tests, correlation analysis has been carried out in order to test remained hypotheses in the study. It can be argued that management support to open innovation correlates with being knowledgeable with open innovation of organization positively and at a low level in technology-intensive companies that operate in science parks in Turkey. Also, there is a low positive correlation between management support to open innovation and implementing open innovation more intensely in these companies. Once again, there is a low positive correlation between being knowledgeable with open innovation of all organization and intensity of open innovation implementation. On the other hand, correlation between being sensitive to protection of intellectual property rights and practicing open innovation is negligible. It can be argued that being sensitive to protection of intellectual property right does not relate to all open innovation practices. In addition, investment on products that fall under open innovation category does not correlate with management support to open innovation. Finally, there is a moderate positive correlation between investment on products that fall under open innovation category and turnover from these products in technology-intensive companies. In that case, science park companies benefit outweigh the investment.

9.2 Conclusion

Based on findings up to now, for technology exploration or inbound open innovation, findings suggest that most of the science park companies benefit from the knowledge of their all employees including non-R&D workers. For technology exploitation or outbound open innovation, findings suggest that most of the technology-intensive companies that operate in science parks involve customers in innovation process to

conduct an active market research to understand needs of them, or develop products on the basis of customer's modification or specification related to similar products of the company.

Open innovation is not yet widespread among technology-intensive companies that operate in science parks in Turkey although it is generally practiced. Inbound open innovation or technology exploration is more preferred by these companies and outbound open innovation or technology exploitation plays a secondary role. It is argued that open innovation is used with an unstructured approach mostly and science park companies that are mostly small and medium-sized enterprises are not confident in their knowledge of open innovation. Therefore, a structured approach to open innovation and assistance to implement such an approach are needed.

9.3 Policy Recommendations

Recommendations are given in order to create awareness about open innovation. Without excepting top management, all employees should be informed about open innovation and encouraged. Non-governmental organizations that will focus on open innovation should be established and undergraduate and graduate schools should open courses regarding open innovation to provide human resource that have the capability needed in open innovation management. Also, open innovation certification programs should be organized in business world. If government supports these programs, they will reach their goals easily. Similar trainings should be designed for companies that operate in science parks specificially. Undoubtedly, trainings organized by university-industry-government collaboration will allow companies to manage their internall processes and be a partner that have the required qualifications by external environment. Moreover, these companies should be encouraged with financial support to open innovation.

9.4 Limitations

This thesis study is the first exploration of open innovation practices in technology-intensive SMEs that operate in science parks in Turkey. Ergo, there are many limitations in the study. First of all, this thesis study have not been able to research all open innovation practices broadly and deeply because of the fact that most

frequently used open innovation practices have been focused on. Also, open innovation practices have been divided into two groups as technology exploration (inbound open innovation) and technology exploitation (outbound open innovation) without considering whether practices are pecuniary or not. Secondly, science park companies have been selected mostly from information and telecommunication sector and the sample is not very extensive. Moreover, lists of motivation factors of open innovation and constraints on open innovation are not perhaps complete list despite the fact that the only focus of this thesis study is not motivation factors and constraints. Another major limitation is that only companies operating in science parks have been studied. Therefore, results cannot be generalized to the all technology-intensive companies in Turkey.

9.5 Further Research

Findings of this study should encourage researchers to study about open innovation in science park companies in spite of limitations. Future attempts to research open innovation should delineate the open innovation practices in a more accurate and detailed way. Open innovation practices can be considered as acquiring, sourcing, selling, and revealing instead of researching two facets of open innovation. Also, further research should broaden the scope by researching open innovation in more extensive and broader sample and including companies from other sectors. Science park companies in Turkey should be compared with science park companies in other countries. On the other side, future studies should also consider companies that do not operate in science parks and similarities and differences between companies that operate in science parks and others should be examined. This thesis study does not reveal interactions between large and small companies in open innovation and future research should focus on interactions between partners of different sizes. Qualitative research methods such as case studies and in-depth interviews should be used in order to research the same subject in further research and similarities and differences should be stated and discussed. Furthermore, further research should use structural equation method (SEM) to develop this thesis study regarding casuality. Final recommendation is that future studies should research future and dynamics of open innovation in technology-intensive companies that operate in science parks.

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APPENDICES

APPENDIX A: Survey
APPENDIX B: Nonoperating Science Parks in Turkey (2014)
APPENDIX C: Characteristics of the Participant Companies
APPENDIX D: Results of Reliability and Factor Analyses

APPENDIX A

To whom it may concern,

Primarily, we would like to present our thanks and congratulations due to your efforts to improve the innovation capacity and R&D performance of our country as a technology manufacturer operating in Science Park.

This survey is conducted for the master thesis whose subject is “Open innovation in technology intensive companies operating in science parks” within the scope of Istanbul Technical University, Graduate School of Science Engineering and Technology, Department of Management Engineering.

Your participation in this study will make a great contribution for determination of the problems and source of these problems, which are faced by the firms operating in science parks, related to the implementation of open innovation practices, identification of improvement areas, preparation of a "proposal document" regarding the solution of these all problems and putting this proposal document into use of the firms.

We thank you so much for your support, attention and cooperation.

Best regards,

Kübra Şimşek – ITU Graduate School of Science Engineering and Technology Management Engineering Graduate Student

Nihan Yıldırım – ITU Department of Management Engineering Lect. Dr.

INSTRUCTIONS:

Survey Structure:

This survey is conducted in order to gather information about open innovation activities of your company.

It is aimed to research in the section,

(A), general business performance of the firm,

(B), innovation performance of the firm,

(C), open innovation performance of the firm

Privacy Policy:

- Information taken from the firms that will participate in the survey will not be shared with any third parties and institutions and a confidentiality agreement will be signed between researchers and company officials.
- In the document and thesis study that survey results will be reported in, company names will not be included; only statistical analysis results, which will be made with the data obtained from the survey, will be shared.
- In addition, if participants want, researchers may provide them results of assessment and comparison regarding companies as a feedback by considering privacy policy.

OPEN INNOVATION ACTIVITIES SURVEY

(A) GENERAL INFORMATION

1. Establishment year of the company:
2. Technology development zone the company operates in:

( ) Ankara (CYBERPARK) Technology Development Zone
( ) Ankara University Technology Development Zone
( ) Bogazici University Technology Development Zone
( ) Bolu Technology Development Zone
( ) Cumhuriyet Technology Development Zone
( ) Canakkale Technology Development Zone
( ) Cukurova Technology Development Zone
( ) Dicle University Technology Development Zone
( ) Dokuz Eylul Technology Development Zone
( ) Duzce Technopark Technology Development Zone
( ) Erciyes University Technology Development Zone
( ) Erzurum Technology Development Zone
( ) Eskisehir Technology Development Zone
( ) Firat Technology Development Zone
( ) Gazi Technopark Technology Development Zone
( ) Gaziantep University Technology Development Zone
( ) GOSB Technopark Technology Development Zone
( ) Hacettepe University Technology Development Zone
( ) ideEGE Technology Development Zone
( ) Istanbul Technology Development Zone
( ) Istanbul University Technology Development Zone
( ) ITU ARI Technology Development Zone
( ) Izmir Technology Development Zone
( ) Kahramanmaras Technology Development Zone
( ) Kocaeli University Technology Development Zone
( ) Lakes Region Technology Development Zone
( ) Malatya Technology Development Zone
( ) Mersin Technology Development Zone
( ) METU Technopolis Technology Development Zone
( ) Namik Kemal University Technology Development Zone

( ) Pamukkale University Technology Development Zone
( ) Sakarya University Technology Development Zone
( ) Samsun Technology Development Zone
( ) Selcuk University Technology Development Zone
( ) Tokat Technology Development Zone
( ) Trabzon Technology Development Zone
( ) Trakya University Edirne Technology Development Zone
( ) TUBITAK Marmara Research Center Technopolis
( ) ULUTEK Technology Development Zone
( ) West Mediterranean Technocity Technology Development Zone
( ) Yildiz Technical University Technology Development Zone

3. Which one best describes your target market?
   ( ) Only internal market
   ( ) Only external market
   ( ) Both internal and external market
4. What is area of activity of your company?
   ( ) Software
   ( ) Hardware
   ( ) Digital Mobile Media
   ( ) Telecommunication Technologies
   ( ) Audio and Video Processing Technologies
   ( ) Other:
5. How would you characterize your company?
   ( ) A subsidiary of an international company
   ( ) An independent company
6. Which one best describes your position in the organization?
   ( ) Company owner
   ( ) Manager
   ( ) Specialist/ Engineer
   ( ) Administrative/ Support Staff
7. How many employees do you have in your organization?
   ( ) 1 – 9
   ( ) 10 – 49
   ( ) 50 – 99
   ( ) 100 – 250

( ) More than 250

8. How much sales revenue (annual turnover) did the company earn during year 2013?

   ( ) less than 1 million TL

   ( ) 1 million TL – 8 million TL

   ( ) 8 million TL – 25 million TL

   ( ) 25 million TL – 40 million TL

   ( ) more than 40 million TL

9. Our company is very sensitive to the protection of intellectual property rights.

   ( ) Agree strongly

   ( ) Agree slightly

   ( ) Neither agree nor disagree

   ( ) Disagree slightly

   ( ) Disagree strongly

(B) INNOVATION

Please answer 1st, 2nd and 3rd questions according to the information below.

"An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations." (Oslo Manual, 2005)

Product (good or service) innovation

"A **product innovation** is the market introduction of a **new** or **significantly** improved **good** or **service** with respect to its capabilities, user friendliness, components or sub-systems.

- Product innovation (new or improved) must be new to your enterprise, but they do not need to be new to your market.
- Product innovations could have been originally developed by your enterprise or by other enterprises.

A **good** is usually a tangible object such as a smart phone, furniture, or packaged software, but downloadable software, music and film are also goods.

A **service** is usually intangible, such as retailing, insurance, educational courses, air travel, consulting etc." (CIS Survey, 2010)

1. During the three years 2012 to 2014, did your enterprise introduce:

   If no to all options, please go to question four.

	Yes	No
New or significantly improved goods (exclude the simple resale of new goods and changes of a solely aesthetic nature)	( )	( )
New or significantly improved services	( )	( )

2. Who developed these product innovations?

   **: Include independent enterprises plus other parts of your enterprise group (subsidiaries, sister enterprises etc.). Institutions include universities, research institutes, non-profits, etc.*

	Product innovation
Your enterprise by itself	( )
Your enterprise together with other enterprises or institutions*	( )
Your enterprise by adapting or modifying goods or services originally developed by other enterprises or institutions*	( )
Other enterprises or institutions*	( )

3. Were any of your product innovations (goods or service) during the three years 2012 to 2014:

	Explanation	Yes	No
New to your market	Your enterprise introduced a new or significantly improved product onto your market before your competitors (it may have already been available in other markets)	( )	( )
Only new to your firm	Your enterprise introduced a new or significantly improved product that was already available from your competitors in your market.	( )	( )

Please answer 4th, 5th and 6th questions according to the information below.

Process Innovation

A **process innovation** is the implementation of a **new** or **significantly** improved production process, distribution method, or supporting activity.

- Process innovations must be new to your enterprise, but they do need to be new to your market.

- The innovation could have been originally developed by your enterprise or by other enterprises.
- Exclude purely organization innovations.

4. During the three years 2012 to 2014, did your enterprise introduce:

   If no to all options, please go to question 4.

	Yes	No
New or significantly improved methods of manufacturing or producing goods or services	( )	( )
New or significantly improved logistics, delivery or distribution methods for your inputs, goods or services	( )	( )
New or significantly improved supporting activities for your processes, such as maintenance systems or operations for purchasing, accounting or computing	( )	( )

5. Who developed these process innovations?

**: Include independent enterprises plus other parts of your enterprise group (subsidiaries, sister enterprise etc.). Institutions include universities, research institutes, non-profits, etc.*

	Process innovation
Your enterprise by itself	( )
Your enterprise together with other enterprises or institutions*	( )
Your enterprise by adapting or modifying processes originally developed by other enterprises or institutions*	( )
Other enterprises or institutions*	( )

6. Were any of your process innovations introduced during the three years 2012 to 2014 new to your market?

   ( ) Yes

   ( ) No

7. During the development of innovation, mark the significance level for the collaborating partners listed below.

   (5) Very important, (4) Important, (3) Moderately Important, (2) Of Little Importance, (1) Unimportant

Collaborating Partner	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Employees	( )	( )	( )	( )	( )
Consultants	( )	( )	( )	( )	( )
Support and Incentive Funds	( )	( )	( )	( )	( )
Development Agencies	( )	( )	( )	( )	( )
Customers	( )	( )	( )	( )	( )
Competitor Companies	( )	( )	( )	( )	( )
Suppliers/ Stakeholders	( )	( )	( )	( )	( )
Technology Transfer Offices	( )	( )	( )	( )	( )
Universities and Other Academic Institutions	( )	( )	( )	( )	( )

(C) OPEN INNOVATION

"Open innovation is the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively." (Chesbrough, 2006)

1. I am knowledgeable about open innovation.

   ( ) Agree strongly

   ( ) Agree slightly

   ( ) Neither agree nor disagree

   ( ) Disagree slightly

   ( ) Disagree strongly

2. Our entire organization is knowledgeable about open innovation.

   ( ) Agree strongly

   ( ) Agree slightly

   ( ) Neither agree nor disagree

   ( ) Disagree slightly

   ( ) Disagree strongly

Please answer 3rd question according to the information below.

- **Idea Competitions/Challenges:** Rewarding individuals, groups or companies for providing ideas to solve specific stated problems in the form of a competition or challenge
- **IP or tech-out licensing or selling:** Licensing or selling your own patents and technology to other organizations or spinning out a new company
- **IP or Tech-in licensing or acquisition:** Licensing or buying patents and technology and incorporating it into your organization
- **Innovation Network:** Incorporating the input from a network of contributors such as innovation hubs, advisory boards and science centers
- **Innovation Intermediaries:** A company which focuses its business on helping other companies implements various facts of OI
- **Collaboration:** Developing new products, services or other capabilities through collaborating with customer, suppliers, or other 3rd partners
- **Customer Immersion:** Observation of the customer-product interaction process to further enhance products or services
- **Lead Users:** Identifying innovations added to your product by users for their own use and then incorporating the ideas back into your product
- **Platforming:** Providing a base product to which customers can extend the capabilities of the product and add value to all involved (such as IPAD and Apple store applications)

3. Please select the options that are suitable for your company according to information given above.
   If "we use already" to any options, please go to question nine.
   (5) We use already, (4) We are about to use/planning to use, (3) Implementation would be good, (2) We do not consider to use, (1) We never use

Open Innovation Practices	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Idea competitions/Challenges	( )	( )	( )	( )	( )
IP or tech-out licensing or selling	( )	( )	( )	( )	( )
IP or Tech-in licensing or acquisition	( )	( )	( )	( )	( )
Innovation Network	( )	( )	( )	( )	( )
Innovation Intermediaries	( )	( )	( )	( )	( )
Collaboration	( )	( )	( )	( )	( )
Customer Immersion	( )	( )	( )	( )	( )
Lead Users	( )	( )	( )	( )	( )
Platforming	( )	( )	( )	( )	( )

4. For how many years has your company been practicing open innovation?
   ( ) Less than 1 year
   ( ) 1-3 years
   ( ) 3-5 years
   ( ) 5-10 years
   ( ) More than 10 years

5. Compared to three years ago, our organization is implementing open innovation more intensely.
   ( ) Agree strongly
   ( ) Agree slightly
   ( ) Neither agree nor disagree
   ( ) Disagree slightly
   ( ) Disagree strongly
6. During the use of open innovation, mark the significance level of each motive below.
   (5) Very important, (4) Important, (3) Moderately Important, (2) Of Little Importance, (3) Unimportant

Motives	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Accelerating time to complete R&D	( )	( )	( )	( )	( )
Minimizing risk of innovation projects	( )	( )	( )	( )	( )
Reducing R&D costs per project	( )	( )	( )	( )	( )
Exploring new technological trends	( )	( )	( )	( )	( )
Identifying new business opportunities	( )	( )	( )	( )	( )
Establishing new partnerships	( )	( )	( )	( )	( )

7. In the last 3 years, how much of your investment did you invest in terms of investment for any innovative product if you consider it will fall under the open innovation category?
   ( ) No investment
   ( ) 1% - 5%
   ( ) 6% - 10%
   ( ) 11% - 15%
   ( ) 16% - 20%
   ( ) More than 20%
8. In the last 3 years, could you please estimate the percent of turnover (annual sales) coming from innovative products those you consider that falls under open innovation category?
   ( ) No investment
   ( ) 1% - 5%
   ( ) 6% - 10%
   ( ) 11% - 15%
   ( ) 16% - 20%
   ( ) More than 20%
9. Compared to three years ago, management support to open innovation has increased.
   ( ) Agree strongly
   ( ) Agree slightly
   ( ) Neither agree nor disagree
   ( ) Disagree slightly
   ( ) Disagree strongly

10. During the use of open innovation, how often do you face constraints given below?
(5) Very Frequently, (4) Frequently, (3) Occasionally, (2) Rarely, (1) Never

Constraints on OI	**Explanation**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Commitment	Lack of employee commitment, resistance to change	( )	( )	( )	( )	( )
Knowledge	Lack of technological knowledge, legal/ administrative knowledge and competent staff	( )	( )	( )	( )	( )
Idea Management	Too many ideas, no management support and formal process of innovation	( )	( )	( )	( )	( )
Intellectual Property Rights	Ownership of developed innovations, user rights when different parties corporate	( )	( )	( )	( )	( )
Finance	Obtaining financial resources	( )	( )	( )	( )	( )
Administration	Bureaucracy, administrative burdens, conflict rules	( )	( )	( )	( )	( )
Resources	Cost of innovation, time and human resources	( )	( )	( )	( )	( )
User acceptance	Adoption problems, customer requirements misjudged	( )	( )	( )	( )	( )
Organization/ culture	Balancing innovation and daily tasks, communication problems, aligning partners, organization of innovation	( )	( )	( )	( )	( )
Customer demand	Too specific demands, innovation appears not fit the market	( )	( )	( )	( )	( )
Partners	Partners does not meet expectations, deadlines are not met	( )	( )	( )	( )	( )
Marketing	Insufficient market intelligence, market affinity, marketing problems with new products	( )	( )	( )	( )	( )
Competent employees	Employees lack knowledge/competences, not enough labor flexibility	( )	( )	( )	( )	( )

Please answer 11th question according to the information below.

Inbound Open Innovation/Technology Exploration: Activities to capture and benefit from external sources of knowledge and technology in order to leverage current knowledge and technological developments.

11. During the use of inbound open innovation, how often do you face constraints given below?

    (5) Very Frequently, (4) Frequently, (3) Occasionally, (2) Rarely, (1) Never

Constraints on Inbound OI	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Not invented here syndrome	( )	( )	( )	( )	( )
No adequate technologies on offer	( )	( )	( )	( )	( )
Too much time and resource requirements	( )	( )	( )	( )	( )
Fear of losing own innovation ability	( )	( )	( )	( )	( )

Please answer 12th question according to the information below.

Outbound Open Innovation/ Technology Exploitation: Transferring firm's own knowledge and technologies outside the firm in order to gain benefit from internal knowledge and technology

12. During the use of outbound open innovation, how often do you face constraints given below?

    (5) Very Frequently, (4) Frequently, (3) Occasionally, (2) Rarely, (1) Never

Constraints on Outbound OI	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Not sold here syndrome	( )	( )	( )	( )	( )
The complexity of the intellectual property rights, fear of infringements	( )	( )	( )	( )	( )
The difficulty of finding buyers	( )	( )	( )	( )	( )
Lack of marketplaces for technologies	( )	( )	( )	( )	( )

13. During the use of open innovation, how often do you face problems regarding human resources?

    (5) Very Frequently, (4) Frequently, (3) Occasionally, (2) Rarely, (1) Never

Human Resources Problems	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Employees are reluctant to share information	( )	( )	( )	( )	( )
The low image of the firm	( )	( )	( )	( )	( )
The high staff turnover	( )	( )	( )	( )	( )

Unpleasant works	( )	( )	( )	( )	( )
Unpleasant working conditions	( )	( )	( )	( )	( )
Lack of skilled manpower	( )	( )	( )	( )	( )
High wage levels	( )	( )	( )	( )	( )

14. Please mark the significance level of actions that you can take if you face a more challenging competitive environment and lower profit margin.

    (5) Very important, (4) Important, (3) Moderately Important, (2) Of Little Importance, (3) Unimportant

Actions	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Increasing the working hours	( )	( )	( )	( )	( )
Increasing product differentiation	( )	( )	( )	( )	( )
Looking for different markets	( )	( )	( )	( )	( )
Reducing prices of goods/services	( )	( )	( )	( )	( )
Improving quality of goods/services	( )	( )	( )	( )	( )
Looking for market niches	( )	( )	( )	( )	( )
Improving marketing activities	( )	( )	( )	( )	( )
Forming strategic partnerships	( )	( )	( )	( )	( )
Reducing production	( )	( )	( )	( )	( )
Reducing production costs	( )	( )	( )	( )	( )

(D) CONTACT INFORMATION

Name Surname:

Company Name:

Company Address:

Telephone Number:

E-mail Address:

Would you like us to share with you a summary of the survey results?

If you would like to see the results of the research, please enter your e-mail address.

APPENDIX B

Table B.1 : Non-operating science parks in Turkey (sagm.sanayi.gov.tr, 2014).

	Technology Development Zone	University	City	Establishment Date
1	ASO Technopolis Technology Development Zone	TOBB University	Ankara	2008
2	Harran University Technology Development Zone	Harran University	Sanliurfa	2010
3	Muallimkoy Technology Development Zone	Gebze Institute of Technology	Kocaeli	2011
4	Yuzuncu Yil University Technology Development Zone	Yuzuncu Yil University	Van	2012
5	Corum Technology Development Zone	Hitit University	Corum	2012
6	Celal Bayar University Technology Development Zone	Celal Bayar University	Manisa	2012
7	Izmir Science and Technology Park Technology Development Zone	Izmir Economy University	Izmir	2012
8	Nigde University Technology Development Zone	Nigde University	Nigde	2012
9	Maku-Baka Technology Development Zone	Mehmet Akif Ersoy University	Burdur	2013
10	Bozok Technology Development Zone	Bozok University	Yozgat	2013
11	Kirikkale University Technology Development Zone	Kirikkale University	Kirikkale	2013
12	Balikesir University Technology Development Zone	Balikesir University	Balikesir	2014
13	Ostim Ekopark Technology Development Zone	Ankara-Gazi-Hacettepe-Atilim-Cankaya-Baskent-TOBB-Turgut Ozal University	Ankara	2014
14	Hatay Technology Development Zone	Mustafa Kemal University	Hatay	2014
15	Ege Technopark Technology Development Zone	Ege-Dokuz Eylul and Yasar University	Izmir	2014
16	Ankara Technopark Technology Development Zone	Yildirim Beyazit University	Ankara	2014
17	Marmara University Technology Development Zone	Marmara University	Istanbul	2014
18	Finans Technopark Technology Development Zone	Bogazici University	Istanbul	2014

APPENDIX C

Table C.1 : Target market.

Target Market	Frequency	Percent
Only internal market	22	21,6
Only external market	1	1,0
Both internal and external market	79	77,5
Total	102	100,0

Table C.2 : Activity area.

Activity Area			
Software	**Yes/No**	**Frequency**	**Percent**
	Yes	78	76,5
	No	24	23,5
	Total	102	100,0
Hardware	**Yes/No**	**Frequency**	**Percent**
	Yes	26	25,5
	No	76	74,5
	Total	102	100,0
Digital Mobile Media	**Yes/No**	**Frequency**	**Percent**
	Yes	11	10,8
	No	91	89,2
	Total	102	100,0
Telecommunication Technologies	**Yes/No**	**Frequency**	**Percent**
	Yes	22	21,6
	No	80	78,4
	Total	102	100,0
Audio and Video Processing Technologies	**Yes/No**	**Frequency**	**Percent**
	Yes	13	12,7
	No	89	87,3
	Total	102	100,0
Other	**Yes/No**	**Frequency**	**Percent**
	Yes	27	26,5
	No	75	73,5
	Total	102	100,0

Table C.3 : Firm type.

Firm Type	Frequency	Percent
A subsidiary of an international company	7	6,9
An independent company	95	93,1
Total	102	100,0

Table C.4 : Position in the organization.

Position in the Organization	Frequency	Percent
Company Owner	57	55,9
Manager	36	35,3
Specialist/ Engineer	7	6,9
Administrative/ Support Staff	2	2,0
Total	102	100,0

Table C.5 : Number of employees.

Number of Employee	Frequency	Percent
1-9	55	53,9
10-49	26	25,5
50-99	6	5,9
100-250	8	7,8
More than 250	7	6,9
Total	102	100,0

Table C.6 : Annual turnover.

Annual Turnover	Frequency	Percent
Less than 1 million TL	64	62,7
1 million TL-8 million TL	18	17,6
8 million TL-25 million TL	11	10,8
25 million TL-40 million TL	6	5,9
More than 40 million TL	3	2,9
Total	102	100,0

APPENDIX D

Table D.1 : Cronbach's alpha if item deleted

	Cronbach's Alpha if Item Deleted
Sensitivity to IPR	,859
Employees	,860
Consultants	,860
Support and Incentive Funds	,859
Development Agencies	,861
Customers	,859
Competitor Companies	,858
Suppliers/ Stakeholders	,854
Technology Transfer Offices	,856
Universities and Other Academic Institutions	,858
I am knowledgeable on the topic of OI	,859
Organization is know. on OI	,857
Idea competitions/Challenges	,857
IP or tech-out licensing or selling	,857
IP or Tech-in licensing or acquisition	,859
Innovation Network	,855
Innovation Intermediaries	,856
Collaboration	,856
Customer Immersion	,858
Lead Users	,858
Platforming	,857
Management Support to OI	,856
Commitment	,856
Knowledge	,853
Idea Management	,855
Intellectual Property Rights	,856
Finance	,855
Administration	,856
Resources	,855
User acceptance	,855
Organization/ culture	,856
Customer demand	,855
Partners	,854
Marketing	,856
Competent employees	,854
Not invented here syndrome	,854
No adequate technologies on offer	,855
Too much time and resource requirements	,854
Fear of losing own innovation ability	,855
Not sold here syndrome	,854
The complexity of the intellectual property rights, fear of infringements	,856
The difficulty of finding buyers	,856
Lack of marketplaces for technologies	,854
Employees are reluctant to share information	,853
The low image of the firm	,854
The high staff turnover	,856
Unpleasant works	,853
Unpleasant working conditions	,852
Lack of skilled manpower	,854
High wage levels	,856
Increasing the working hours	,861
Increasing product differentiation	,861
Looking for different markets	,861
Reducing prices of goods/services	,859
Improving quality of goods/services	,861
Looking for market niches	,860
Improving marketing activities	,861
Forming strategic partnerships	,862

Reducing production	,865
Reducing production costs	,857
Implementing OI more intensely	,857
Accelerating time to complete R&D	,858
Minimizing risk of innovation projects	,856
Reducing R&D costs per project	,857
Exploring new technological trends	,857
Identifying new business opportunities	,857
Establishing new partnerships	,857

Table D.2 : Total Variance Explained.

TOTAL VARIANCE EXPLAINED

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8,972	35,887	35,887	8,972	35,887	35,887	3,755	15,019	15,019
2	1,970	7,881	43,768	1,970	7,881	43,768	3,205	12,820	27,839
3	1,700	6,801	50,569	1,700	6,801	50,569	2,896	11,585	39,424
4	1,514	6,055	56,624	1,514	6,055	56,624	2,594	10,377	49,801
5	1,363	5,454	62,078	1,363	5,454	62,078	2,128	8,512	58,313
6	1,163	4,653	66,731	1,163	4,653	66,731	2,104	8,418	66,731
7	,857	3,428	70,159						
8	,840	3,359	73,517						
9	,743	2,971	76,489						
10	,662	2,646	79,135						
11	,599	2,397	81,532						
12	,566	2,264	83,796						
13	,521	2,085	85,881						
14	,488	1,951	87,832						
15	,438	1,751	89,583						
16	,399	1,597	91,180						
17	,357	1,429	92,609						
18	,305	1,220	93,829						
19	,292	1,169	94,997						
20	,262	1,048	96,046						
21	,247	,987	97,033						
22	,218	,871	97,904						
23	,199	,796	98,700						
24	,176	,702	99,402						
25	,149	,598	100,000						

Extraction Method: Principal Component Analysis.

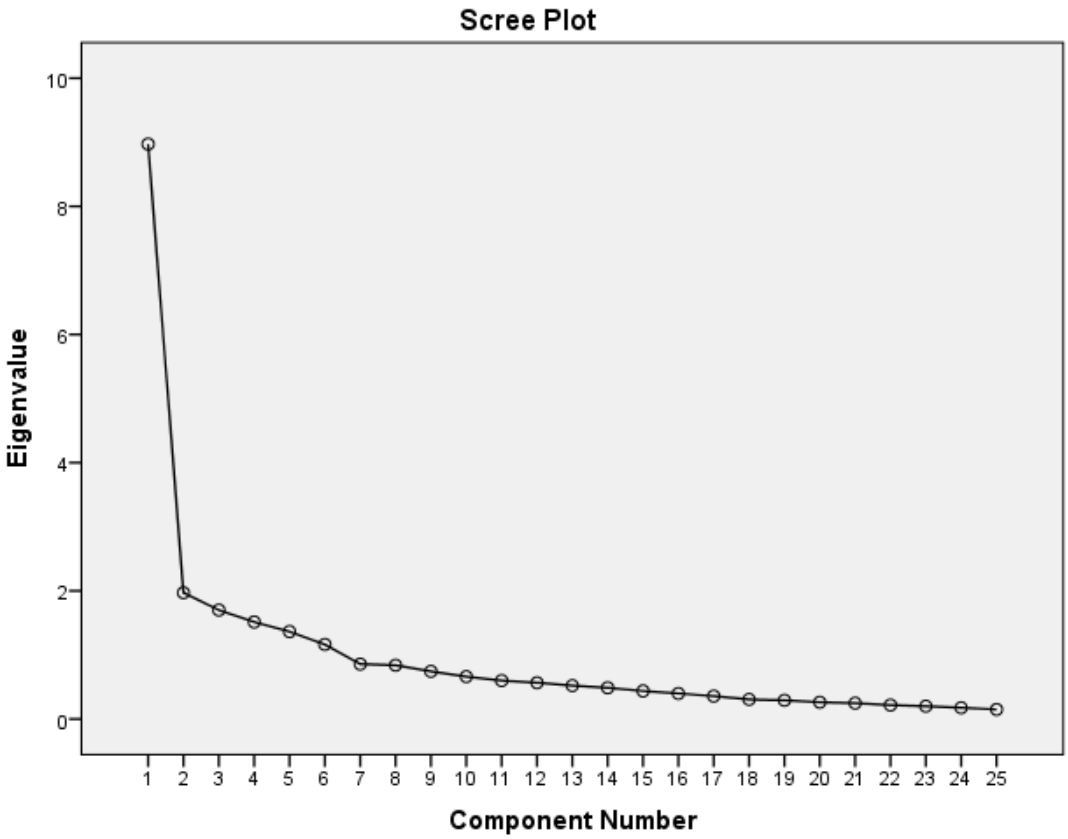

Figure D.1 : Scree Plot.

CURRICULUM VITAE

Name Surname: Kübra Şimşek

Place and Date of Birth: Malatya 11.08.1990

E-Mail: simsekkub@itu.edu.tr

EDUCATION:

B.Sc.: 2012, Beykent University, Mathematics and Computing

2012, Beykent University, Management Information Systems

PUBLICATIONS, PRESENTATIONS AND PATENTS ON THE THESIS:

- Yildirim, N. and Simsek, K., 2015. Challenges in Open Innovation for ICT Companies in University Technology Development Zones, *24th International Conference on Management of Technology – IAMOT*, June 8-11, 2015 Cape Town, South Africa.
- Yildirim, N. and Simsek, K, 2015. Trends and Motives in Open Innovation for ICT Companies in Technology Development Zones, *15. Üretim Araştırmaları Sempozyumu –UAS15*, October 14-16, 2015 Izmir, Turkey.