İSTANBUL TECHNICAL UNIVERSITY ★ INSTITUTE OF SCIENCE AND TECHNOLOGY

A FRAMEWORK FOR INNOVATION MANAGEMENT BASED ON AXIOMATIC DESIGN: INNOVATION ORIENTED ORGANIZATION

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Programme : Engineering Management

JUNE 2010

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Date of submission : 07 May 2010
Date of defence examination: 09 June 2010

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JUNE 2010

İSTANBUL TEKNİK ÜNİVERSİTESİ ★ FEN BİLİMLERİ ENSTİTÜSÜ

AKSİYOMLARLA TASARIM YÖNTEMİ İLE GELİŞTİRİLMİŞ YENİLİKÇİLİK YÖNETİM MODELİ: YENİLİKÇİLİK ODAKLI ORGANİZASYON

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Tezin Enstitüye Verildiği Tarih : 07 Mayıs 2010
Tezin Savunulduğu Tarih : 09 Haziran 2010

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HAZİRAN 2010

FOREWORD

I would like to express my deep appreciation and thanks for my advisor Prof. Dr. Cengiz Güngör for his support and valuable advice during my study. Also, I would like to thank the faculty and staff of the Department of Industrial Engineering for providing excellent academic education and complete understanding of the aspects of management field during my graduate career at the Istanbul Technical University.

I would have never been able to carry out this study without my beloved mother, Ayşe Kuzucu, and father, İdris Kuzucu, who give me their great support, understanding and wisdom during all my life, as well as my adorable brother, Aykut Kuzucu, who just makes me happy even with his humorous nature itself. They are irreplaceable and no word can express my gratefulness to their presence.

I want to express my special thanks and love to my dearest friend, Esra Yıldız, who is always with me. During this study, her great support and motivation made hard times easier for me.

I should not forget the encouraging guidance of my managers, Öner Tekin and Taner Arıkan. They have been great role models for me.

In addition, I am indebted to TÜBİTAK for the scholarship provided during my master education.

Finally, I would like to thank all my friends and relatives who make my life more meaningful with their presence.

This work has been dedicated to all these glorious people.

June 2010

Burak Kuzucu

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ABBREVIATIONS

IOO	**:** Innovation Oriented Organization
AD	**:** Axiomatic Design
GST	**:** General Systems Theory
FR	**:** Functional Requirement
DP	**:** Design Parameter
ICT	**:** Information and Communication Technologies
BCG	**:** Boston Consulting Group

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A FRAMEWORK FOR INNOVATION MANAGEMENT BASED ON AXIOMATIC DESIGN: INNOVATION ORIENTED ORGANIZATION

SUMMARY

In today's hyper-competitive business world, companies are facing with brutal competition; market shares are decreasing due to globalization, customers' demand on individualization are increasing, time to market and uniqueness are gaining importance. These changing conditions force companies to focus on development new products, processes or services, with the aim of providing customers with increased functionality and performance in order to sustain competitive advantage.

Companies need to find new ways to differentiate from the challenging environment by ensuring competitive advantage. In this aspect, innovation is widely recognized as an essential element of company business strategies and core values since it significantly contributes to competitive success.

As the importance of innovation increases for sustainable competitive advantage, it becomes vital how to manage it. Thus, innovation management concept has become the focal point of intensive academic and industrial research that aims to find ways for achieving sustainable competitive advantage in the global competition.

The purpose of this study is to present a comprehensive and integrated framework for organization-wide innovation management, which is obviously necessary to sustain competitive advantage in the challenging environment. The framework aims to guide companies how they could transform themselves into an innovation oriented organization by managing innovation process systematically and improving innovation competencies continuously.

Through an extensive review of literature, the framework was developed for organization-wide innovation management; general system approach was used to identify the key concepts of innovation management and axiomatic design methodology was employed to determine the core components of the innovation management framework and decompose them into sub-components. With the aim of validation of the proposed framework, an empirical survey was conducted to collect data from companies in information and communication technologies industry in Turkey, and multiple regression analysis was employed on the collected data to confirm the framework.

This exploratory study introduces a coherent and integrated framework for organization-wide innovation management by using axiomatic design methodology and general system theory. This approach provides a scientific and systematic way in effective design of innovation management framework.

Future research may focus on building an innovation assessment model based on the framework developed in this research. This assessment model could practically help companies to monitor and evaluate their innovation management competencies.

AKSİYOMLARLA TASARIM YÖNTEMİ İLE GELİŞTİRİLMİŞ YENİLİKÇİLİK YÖNETİM MODELİ: YENİLİKÇİLİK ODAKLI ORGANİZASYON

ÖZET

Günümüz iş dünyasında, rekabet her geçen gün giderek şiddetlenmektedir; küreselleşmeyle birlikte pazar payları azalmakta, müşterilerin kişiselleştirilmiş ürün ve hizmet talepleri artmakta, zaman ve farklılık kavramlarının önemi yükselmektedir. Bu durum; şirketleri, varlıklarını devam ettirebilmek adına, müşterilerin beklentilerini karşılayacak yüksek işlevselliğe ve performansa sahip yeni ürünler, hizmetler ve süreçler geliştirmeye odaklanma yönünde zorlamaktadır.

Şirketler, bu zorlu rekabet ortamından farklılaşmak amacıyla yeni yollar bulmak zorundalar. Bu bakımdan, rekabetçi üstünlük elde etmede önemli bir paya sahip olan yenilikçilik kavramının, şirketin iş stratejilerinin ve temel değerlerinin merkezine yerleştirilmesi gerekmektedir.

Sürdürülebilir rekabet avantajı elde etmede yenilikçilik kavramının öneminin artmasıyla birlikte, yenilikçilik sürecinin başarılı bir şekilde yönetilebilmesi organizasyonlar için zaruri bir hale gelmektedir. Bu nedenle, yenilikçilik yönetimi kavramı, küresel rekabet ortamında sürdürülebilir rekabetçi üstünlük elde etmenin yollarını bulmak amacıyla hem akademik hem de endüstriyel çalışmaların yoğun bir şekilde odak noktası haline gelmektedir.

Bu çalışmanın amacı, meydan okuyan rekabet ortamında hayatta kalabilmek adına organizasyonların açıkça gereksinim duymakta oldukları yenilikçilik yönetimi için kapsamlı ve bütüncül bir model tasarlamaktır. Geliştirilen modelin, şirketlere, yenilikçilik sürecini sistematik bir şekilde yönetebilen ve yenilikçilik yetkinliklerini sürekli geliştirebilen, yenilikçilik odaklı bir organizasyona dönüşebilmeleri yolunda rehberlik etmesi amaçlanmaktadır.

Geniş çaplı bir kaynak taraması sonrasında, örgütsel çaplı yenilikçilik yönetim modeli geliştirilirken; yenilikçilik yönetiminin anahtar kavramlarını ortaya koymak üzere genel sistem yaklaşımından, modelin temel bileşenleri ile alt bileşenlerini belirlemek üzere de aksiyomlarla tasarım yönteminden yararlanılmıştır. Modelin doğruluğunu araştırmak için ise, Türkiye bilgi ve iletişim teknolojileri sektöründe yer alan şirketlerden bilgi toplamak amacıyla bir anket çalışması düzenlenmiş ve elde edilen veriler çoklu regresyon analizi yöntemi ile incelenmiştir.

Bu çalışma, yenilikçilik yönetimine yönelik olarak ortaya koymuş olduğu kapsamlı ve bütüncül modeli, aksiyomlarla tasarım yöntemi ve genel sistem teorisine dayandırmaktadır. Bu yaklaşım, tasarlanan yenilikçilik odaklı organizasyon modeline bilimsel ve sistematik bir kimlik kazandırmaktadır.

Bu çalışmanın devamında, geliştirilmiş olan modelden yararlanılarak, şirketlerin yenilikçilik yönetimine yönelik faaliyetlerini izleyebilmeleri ve değerlendirebilmeleri amacıyla yenilikçilik değerlendirme modeli geliştirilmesi üzerine odaklanılabilinir.

1. INTRODUCTION

1.1 Background

In today's business world, the competition is getting more challenging as nicely described by D'Aveni (1994) with the concept of 'hyper-competition'; market shares are decreasing due to globalization, customers' demand on individualization are increasing, time to market and uniqueness are gaining importance. In the hyper-competition era, companies are facing with increasing challenges. Market segments are fragmenting and demands for customized deliveries are forcing companies to produce differentiated products and services. As stated by Cobbenhagen (2000), customers are becoming ever more discerning and are imposing apparently conflicting demands on firms: customized solutions, fast delivery, high quality and sound environmental performance. Companies rise to the challenge, and live up these demands by delivering the products and services their customers want, with more features, better performance and appropriate levels of cost and quality.

These changing conditions force companies to focus on development new products, processes or services, providing the customer with increased functionality and performance in order to create value. The increased competitiveness of marketplaces requires all businesses to make better use of their technological, organizational and marketing competences in order to survive in the long term.

Companies need to find new ways to differentiate from the competitive environment by ensuring competitive advantage. In this aspect, innovation is considered as an essential element of company business strategies and core values for sustaining competitiveness and ensuring an organization's potential (Krause, 2004). Innovation is widely recognized as critical source and driver for company's survival by facilitating to penetrate new markets, with the aim of spreading out the existent market share and providing the company an increased competitive advantage. Dooley and Sullivan (2003) emphasize that becoming an innovative organization is a

means to compete and keep survivability in dynamic and changing business environment.

Innovation is widely acknowledged by industry and academics as an essential competitive enabler for any organization that wishes to remain competitive, and survive and grow (EU European Commission, 2004). There are a lot of researches related to innovation management concept owing to the critical role of managing innovation systematically (Chanal, 2004; Huergo, 2006). However, as stated by Cormican and O'Sullivan (2004), many organizations fail to manage organization-wide innovation systematically and still lack of capability to sustain innovation over the long-term. In addition to academic commentary, the annual innovation survey report of The Boston Consulting Group (2009) declares that many organizations do not generate satisfactory profit or competitive advantage in spite of the high awareness of the importance of organization-wide innovation.

A combination of innovative ideas and good organizational innovation management is the key to sustaining competitive organizational innovation in the long-term (Ahmed, 1998; Adams et al., 2006). It is widely confirmed that innovative firms tend to have larger market shares and higher growth rates and profits than non-innovative firms (Geroski and Machin, 1992). Thus, innovation management concept has become the focal point of intensive academic and industrial research that aims to find ways for achieving sustainable competitive advantage in the global competition (Drucker, 1985; Hitt et al., 2001; Kuratko et al., 2005). As the importance of innovation increases for sustainable competitive advantage, it becomes vital how to manage it.

In fact, achieving successful innovation is not simple for most organizations as it innately cannot easily be interpreted (Dougherty and Hardy, 1996). While innovation is a way to survive, it is also an easy way to get into financial trouble because of its risk intensive characteristics (Cobbenhagen, 2000). This situation raises the question as to how innovative success can be achieved and sustained in the long term.

1.2 Purpose of the Thesis

Innovation as an activity is nothing new. It is something humans have been engaged in ever since they invented the first stone tools and put them to use. According to

Cobbenhagen (2000), the change occurs on the pace at which companies have to innovate; and the inherent demands posed on the management of companies to master innovation efficiently and effectively.

Although many innovation management related studies have been conducted, and the need for an innovation management framework is addressed in the literature (Verhaeghe and Kfir, 2002; Cormican and O'Sullivan, 2004), a complete organization-wide view is not available yet. Adams et al. (2006) describe this situation as follows:

"It is difficult to identify a bounded body of literature in which a comprehensive discussion of innovation measurement issues might be located… The consequence of this is the absence of a holistic framework covering the range of activities required to turn ideas into useful and marketable product…"

In response to the mentioned absence, the purpose of this study is to present a comprehensive and integrated framework for managing organization-wide innovation, which is obviously essential to sustain competitive advantage in the challenging environment. The framework proposed in this research aims to guide the companies in understanding how to transform themselves into an innovation oriented organization by managing innovation process systematically and improving innovation competency continuously. Objectives of study are listed below:

- Identify the key concepts of organization-wide innovation management from the perspective of general system approach,
- Design a framework of innovation oriented organization by using axiomatic design methodology, and
- Assess empirically the framework through the survey conducted for the companies from information and communication technologies industry in Turkey.

1.3 Significance of the Thesis

Numerous studies focusing on the success factors of innovation processes can be found in the literature. Although there is a lot of research related to innovation management concept (Chanal, 2004; Huergo, 2006), much of them have been done

in an inconclusive and inconsistent way, and are characterized by low levels of explanation (Cooper, 1994; Adams et al., 2006). As stated by Cobbenhagen (2000), in the literature there was no comprehensive list of innovation success factors at organizational level. All existent frameworks of innovation management have been built on critical factors identified through intensive literature review; a systematic and scientific design methodology has never been developed and employed for organization-wide innovation management.

This exploratory study introduces an integrated and holistic framework for organization-wide innovation management by using axiomatic design methodology and general system approach. General system approach was used to identify the key concepts of innovation management, and axiomatic design methodology was employed to determine the core components of the innovation management framework and decompose them into sub-components. This approach provides a scientific and systematic way in effective design of innovation oriented organization.

1.4 Thesis Outline

The introduction section provides an overall understanding of the dissertation by expressing the background and purpose of this study. The next two sections include extensive literature reviews on innovation theory and axiomatic design methodology. In section 4, innovation oriented organization framework is designed by using general system approach and axiomatic design methodology. The next section explains the empirical analysis methodology that has been followed to validate the proposed framework. After collecting the responses of the survey, results are statistically introduced and analyzed in section 6. Then, the proposed framework and its components are discussed in light of findings. Finally, the dissertation is concluded by expressing the implications and limitations of the study.

2. INNOVATION THEORY

2.1 Definition of Innovation

Schumpeter (1942) talks of a process "creative destruction" where there is a constant search to create something new, which simultaneously destroys the old rules and establishes new ones – all driven by the search for new source of profits. In his view:

"What counts is competition from the new commodity, the new technology, the new source of supply, the new type of organization… competition which… strikes not at the margins of the profits and the outputs of the existing firms but at their foundations and their very lives."

This view points the concept of innovation, which is defined by Schumpeter (1934) as innovation and it is described as the implementation of new combinations, which include product and process innovations as well as organizational innovations and the new access to markets of suppliers or consumers.

Dictionaries define 'innovation' as 'introducing something new': the Latin stem 'innovare' refers to altering or renewing, and is derived from 'novus', meaning 'new' (Little et al., 1973). The term innovation, most generally, implies newness (Johannessen et al., 2001). That is, an innovation is something that is new, is positively different, or is better than what was there before.

In the literature, the term 'innovation' has been used to describe both the process that uses new knowledge, technologies and processes to generate new products as well as the new or improved products themselves (Porter, 1990). Some authors have reserved the term 'innovation' just for the result of the innovation process, and 'innovation management' for the managerial activities that attempt to control the innovation process (Drejer, 2002). On the other hand, greater part of the literature considers innovation as a process of turning creative ideas into valuable solutions to create value for targeted customers. Drucker (1985) describes that innovation refers to an outcome of an innovative process or to the innovative process itself. In addition, Tushman and Nadler (1986) define innovation as the creation of a product,

service, or process that is new for a particular business unit. Innovation has been characterized as a process of commercialization of a newly developed product or practice (Freeman, 1982; Dickson and Hadjimanolis, 1998).

Innovative activity may relate to new products, new services, new methods of production, opening new markets, new sources of supply, and new ways of organizing. An innovation is the implementation of a new or significantly improved product, or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations (The OECD Oslo Manual, 2005).

From the organization-wide perspective, innovation includes the development of new products or process in technology as well as new forms of structure or strategy in management and it enables an organization to generate a competitive advantage (Damanpour, 1991). Organization-wide innovation is considered as the interaction of organizational resources and internal environment with the external environment by changes and transformation in order to achieve organization's strategy or goals.

The simplest definition of innovation is the successful exploitation of new ideas. According to Tidd et al. (2001), innovation is more than simply coming up with good ideas; it is the process of growing them into practical use. From this point of view, invention is considered as only the first step in a long process of bringing a good idea to widespread and effective use. At this point, the critical difference between innovation and invention can be exemplified with a dramatic story (Tidd et al., 2001):

"A Boston man called Elias Howe produce the world's first sewing machine in 1846. Unable to sell his ideas despite travelling to England and trying there, he returned to the USA to find one Isaac Singer had stolen the patent and built a successful business from it. Although Singer was eventually forced to pay Howe a royalty on all machines made, the name which most people now associate with sewing machines is Singer not Howe".

2.2 Innovation Types

Innovation as a term is not only related to products and processes, but is also related to marketing and organization. Schumpeter (1934) describes different types of

innovation: new products, new methods of production, new sources of supply, the exploitation of new markets, and new ways to organize business. In a similar manner, the OECD Oslo Manual (2005) introduces four different innovation types: product innovation, process innovation, marketing innovation and organizational innovation.

Product innovation is the introduction of a good or service that is new or significantly improved regarding its characteristics or intended uses; including significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics (The OECD Oslo Manual, 2005). Product innovation is a difficult process driven by advancing technologies, changing customer needs, shortening product life cycles, and increasing global competition. For success, it must involve strong interaction within the company and further between the company and its customers and suppliers (Akova et al., 1998).

Process innovation is the implementation of a new or significantly improved production or delivery method. Process innovations can be intended to decrease unit costs of production or delivery, to increase quality, or to produce or deliver new or significantly improved products (The OECD Oslo Manual, 2005). Fagerberg et al. (2004) stress that while the introduction of new products is commonly assumed to have a clear, positive effect on the growth of income and employment, process innovation, due to its cost-cutting nature, can have a more hazy effect.

Marketing innovation is the implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing (The OECD Oslo Manual, 2005). Marketing innovation targets at addressing customer needs better, opening up new markets, or newly positioning a firm's product on the market with the intention of increasing firm's sales. From the perspective of Kotler (1991), marketing innovation is strongly related to four P's of marketing, which is the combination of product, price, place, and promotion.

Finally, organizational innovation is the implementation of a new organizational method in the firm's business practices, workplace organization or external relations. Organizational innovations have a tendency to increase firm performance by reducing administrative and transaction costs, improving workplace satisfaction, gaining access to non-tradable assets or reducing costs of supplies (The OECD Oslo

Manual, 2005). Organizational innovation is strongly related with all the administrative efforts of renewing the organizational routines, procedures, mechanisms, systems etc. to promote teamwork, information sharing, coordination, collaboration, learning, and innovativeness.

Francis and Bessant (2005) introduce a different approach for defining innovation categories: the 4P's of innovation. These four categories are shortly expressed in Table 2.1.

Table 2.1: The 4P's of innovation (Francis and Bessant, 2005)

Innovation Type	Definition
Product Innovation:	changes in the product/services which organization offers
Process Innovation:	changes in the ways in which product/services are created and delivered
Position Innovation:	changes in the context in which product/services are introduced
Paradigm Innovation:	changes in the underlying mental models which frame what the organization does

From the level of novelty point of view, innovation is classified into two categories: incremental innovation and radical innovation. As described by Schumpeter (1934), radical innovation shapes big changes in the world, whereas incremental innovation fills in the process of change continuously.

Incremental innovation has smaller changes in the existing products, makes full use of the present technical potential, strengthens the current predominance, and has relatively low requirements for technology capability, scale of the enterprise (Nelson and Winter, 1982). Though the incremental innovation has not utilized some new scientific principles, it will still bring enormous accumulative effects on enterprise owing to the long time accumulation and storage in technology, organization, market and other resources.

Radical innovation is established on the basis of a set of different scientific and technical principles and it will bring new market chance (Dewar and Dutton, 1986). Radical innovation is usually the foundation for new enterprises to enter to the market successfully, and it may cause a reshuffle of the whole industry. A large number of empirical studies ink that with constant progress of technology and

quickening process of international economy integration, the existing large-scale company may lose its leader position when confronting with the rival with breakthrough innovative achievements (Fu and Zhang, 2004).

These two different categorizations of innovation are conceptualized together and named as ‘innovation space’ by Tidd et al. (2001). Innovation space is mapped in Figure 2.1.

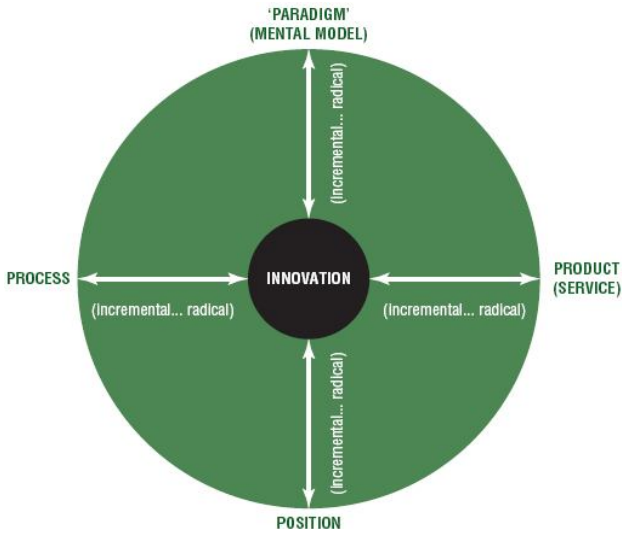


Figure 2.1: Innovation space (Tidd et al., 2001)

2.3 Evolution of Innovation Models

Roy Rothwell (1994), one of the key researchers in the field of innovation management, provides a useful historical perspective on innovation management. He approaches the evolution of innovation from simple linear models to increasingly complex interactive models. After investigating the nature of innovation, he identified five generations of innovation providing an historic overview of innovation management between the 1950’s and 2000’s.

2.3.1 Technology Push Model

During the first 20 years or so following the Second World War, unparalleled rates of economic growth increased the advanced market economies through rapid industrial expansion. New industries based largely on new technological opportunities were emerged and these developments resulted in rapid employment creation, rising prosperity and an associated consumer boom. In consequence of these developments,

rapid growth of the consumer demand was increased and companies focused to create new product ranges with the aim of satisfying the burgeoning demand.

Under these conditions, it is not surprising that the process of the commercialization of technological change was generally perceived as a linear progression, which started with a scientific discovery, progressed through technological development in firms, and resulted in the marketplace. The general assumption in this first generation, or technology push, was that more research and development activities resulted in more successful new products and company accomplishment (Rothwell, 1994).

2.3.2 Market Pull Model

Towards the second half of the 1960s, manufacturing productivity continued to increase considerably and levels of prosperity remained high (Rothwell and Soete, 1983). New products were based mainly on existing technologies, and supply and demand were balanced in many industries.

During this period, due to intensifying competition, investments on new product and related expansionary technological change were decreased; on the other hand, investments on rationalization technological change were increased. Strategic emphasis on marketing was grown, as large and highly efficient companies fought for market share. Perceptions of the innovation process began to change with a marked shift towards emphasizing demand side factors. This resulted in the emergence of the second generation or market-pull model of innovation (Rothwell, 1994).

2.3.3 Coupling R&D and Marketing Model

The early to late 1970s was a period marked by high rates of inflation, demand saturation and growing structural unemployment. Consolidation and rationalization were on the focus of company strategies, with growing emphasis on scale and experience benefits. Moreover, issues related to accountancy and financing were leading to a strategic focus on cost control and cost reduction.

Under the constraints of resources, it became increasingly necessary to understand the basis of successful innovation in order to reduce the incidence of wasteful failures. In result, a number of detailed empirical studies related to innovation

process were published with the aim of modeling successful innovation process for the first time. According to the results of these empirical studies, the technology-push and need-pull models of innovation were extreme and atypical examples of a more general process of interaction between technological capabilities and market needs (Rothwell, 1994). As a general perception of this era, success was associated with doing most tasks competently and in a balanced and well-coordinated manner. In addition, key individuals with entrepreneurial flair and a strong personal commitment to innovation were at the very heart of the successful innovation process.

2.3.4 Integrated Business Processes Model

The early 1980s heralded a period of economic recovery in that companies mainly focusing on core businesses and technologies (Peters and Waterman, 1982). Strategic emphasis on technological accumulation was increased due to growing awareness of the strategic importance of evolving generic technologies. Some important events could be listed as follows: the notion of global strategy emerged (Hoad and Vahlne, 1988), and a rapid growth occurred in the number of strategic alliances between companies (Contractor and Lorange, 1988; Dodgson, 1993). In addition to large firms, innovative small firms were engaging in intensive external networking activity (Rothwell, 1991). Because of shortening product life cycles, speed of development became an increasingly important factor in competition leading firms to adopt time-based strategies (Dumaine, 1989).

As a crucial feature of this period, Japanese companies were recognized with their remarkable competitive performance in world markets. Rothwell (1994) describes this situation as follows: “It was realized that the Japanese were powerful innovators in their own right and there were features of the Japanese new product development system that enabled them to innovate more rapidly and efficiently than their Western counterparts”. Two main features of innovation in leading Japanese companies were found out as integration and parallel development. Japanese companies were integrating their suppliers into the new product development process at an early stage. For parallel development, different in-house departments of the companies were working on the project simultaneously rather than sequentially (Rothwell, 1994).

2.3.5 System Integration and Networking Model

Since the early of 1990s, leading companies were committed to technological accumulation; strategic networking continued; speed to market remained of importance; firms were striving towards increasingly better-integrated product and manufacturing strategies; greater flexibility and adaptability were being sought; and product strategies were more strongly emphasizing quality and performance features (Rothwell, 1994). One of these dominant elements of corporate strategy has attracted most attention during the early 1990s is that of speed of development. Being a fast innovator is an important factor for company's competitiveness, especially in areas where rates of technological change are high and product cycles are short. Thus, in an intensely competitive environment, many companies are forced to accelerate product development rates in order to survive.

The fifth generation innovation model is essentially a development of the fourth generation innovation model in which the technology of technological change is itself changing. Rothwell (1994) describes this situation as follows: "The fifth generation innovation model provides some indication of the nature and scope of the actions leading innovator companies are taking to enhance the speed, efficiency and flexibility of their product development activities. These include, centrally, integrated and parallel development processes, strong and early vertical linkages, devolved corporate structures and the use of electronics-based design and information systems."

According to Rothwell (1994), the main characteristics of the fifth generation innovation model are as follows: greater overall organizational and systems integration, flatter and more flexible organizational structures, fully developed internal databases, electronically assisted product development, and effective external electronic linkages. In short, the key aspects of the fifth generation innovation model are integration, flexibility, networking and parallel information processing (Rothwell, 1994).

2.4 Need for Managing Innovation

Innovation is the last remaining frontier in today's world of business, helping companies to achieve lower cost, superior performance, and new products and

services (Pospisil 1996; Reed et al., 1996). Companies exhibiting competitive advantage, which means the ability to win and do it continuously, demonstrate timely responsiveness and rapid product innovation, coupled with the management capability to effectively co-ordinate and redeploy internal and external competencies (Tidd et al., 2001). In an environment where technologies, competitive positions and customer demands can change almost overnight and the life cycles of products and services are getting shorter, the capacity to manage innovation successfully is crucial for the competitive power of a company. Innovation is not only of importance for a limited group of high-tech, manufacturing or large-scale companies; the need to innovate is universal, irrespective of size, sector or technological sophistication (Cobbenhagen, 2000). Therefore, it is no surprising that innovation management concept has become the focal point of intensive academic and industrial research that aims to find ways for achieving sustainable competitive advantage in the global competition (Drucker, 1985; Hitt et al., 2001; Kuratko et al., 2005).

However, innovation is not a steady-state process in the classical sense. Rather, it is a complex, non-routine process that confronts the organization with dilemmas and uncertainties, which are mostly unknown to production processes. The risks and costs involved, as well as the complexity and uncertainties, make innovation a difficult process to manage. Furthermore, global trends are setting increasingly stringent demands with respect to the effectiveness and efficiency of a firm's innovative efforts (Cobbenhagen, 2000).

Dickson and Hadjimanolis (1998) state that innovation management corresponds to the management of the whole process of innovation from the idea generation stage through product or process development/adaptation to launch in the market or start; and it includes both strategic and operational issues. Kaufmann and Todtling (2002) indicate that innovation requires a favorable environment within the organization that is fostered by issues such as top management support, the implementation of successful technology strategy, the design of an organizational structure that facilitates the innovation process, technology culture, and human resources with necessary skills and experience. Adams et al. (2006) emphasize that the innovation capacity of organizations is determined by multiple factors that relate both to their own internal organization and to their market environment and the task of generating and then converting ideas into usable and marketable products requires high levels of

interfunctional co-ordination and integration. Tidd et al. (2001) state that innovation requires as much an inside-out attitude as an outside-in approach; innovative success is not just determined by R&D, but throughout the whole innovation chain, from the conception of an idea to the first product sold market and beyond.

Within the attempts to formulate an innovation theory, there are two positions. One is the internally oriented, resource-based position (Hamel and Prahalad, 1994; Foss, 1997), which emphasizes the assets or resources of the company. The other is the external, strategic market-oriented position (Porter, 1990). There is no conflict between these two positions; they emphasize different aspects of modern innovation and may be considered as complementary (Elgar, 2001). There is interplay between external and internal forces, and if internal processes do not work, there will be no innovations (Elgar, 2001).

From a different point of view, managing innovation does not only mean developing products that meet the real needs of the customers, but also nurturing and developing what a company is best at in various aspects; technology, marketing, logistics, service and management (Cobbenhagen, 2000). Therefore, as emphasized by Drucker (1999), understanding how to manage innovation successfully is crucially important in a time when innovation is an almost obligatory survival strategy.

3. AXIOMATIC DESIGN METHODOLOGY

Axiomatic Design (AD) is a general design methodology introduced by Suh (1990) with the aim of offering a scientific base for design in an effective way. It is introduced as a significant departure from the conventional design process, which has been dominated by empiricism and intuition. In the literature, there are many applications of AD methodology for designing products, systems, organizations and software.

Axiomatic Design provides a theoretical foundation based on logical and rational thought processes and tools in order to establish a scientific basis for design and to improve design activities. The goal of AD methodology is manifold: to make human designers more creative, to reduce the random search process, to minimize the iterative trial-and-error process, to determine the best designs among those proposed, and to endow the computer with creative power through the creation of a scientific base for the design field (Suh, 2001). To realize this goal, the AD methodology offers a systematic process to perform the search process through the design space and determine the best design solution among many alternatives more effectively (Kulak et al, 2005).

Axiomatic Design is based on the common activities and elements that are present in all good designs. These activities, which are determined by Suh (2001), are listed as follows:

- Know or understand the customer needs,
- Define the problem to be solved to satisfy the needs,
- Conceptualize the solution through the synthesis,
- Perform analysis to optimize the proposed solution, and
- Check the resulting design solution to see if it meets the original customer needs.

As introduced by Suh (2001), Axiomatic Design methodology includes four domains: the customer domain, the functional domain, the physical domain and the process domain. In the customer domain, there are customers' needs or expectations from a product, service or system. The functional domain includes customer needs transformed into functional requirements. To answer the functional requirements, physical domain has design parameters. Finally, process domain is characterized by the process variables to develop a process for production. These four domains and mapping between them are illustrated in Figure 3.1.

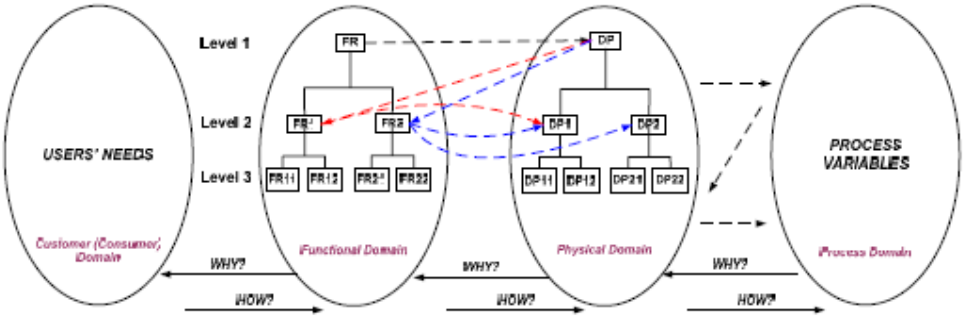


Figure 3.1: Hierarchical tree structures of AD domains (Kim and Suh, 1991)

The most important concept in Axiomatic Design is the existence of the design axioms. Suh (1990) identified two general axioms by examining the common elements that are always present in good designs. These axioms are briefly introduced in Table 3.1.

Table 3.1: Design axioms of AD methodology

Design Axiom	Explanation
Axiom 1 – Independence Axiom:	The independence of the functional requirements must always be maintained, where functional requirements are defined as the minimum set of independent requirements that characterizes the design goals.
Axiom 2 – Information Axiom:	Among the designs that satisfy the Independence Axiom, the design that has the smallest information content is the best design.

The first axiom is related to the nature of mapping between "what is required" and "how to achieve it". For a design to be acceptable, the design must satisfy the first axiom. On the other hand, the second axiom is useful in comparing design solutions that satisfy the first axiom and determining the best among them. The design solution

with the least amount of information is the most acceptable or best design which characterized by uncoupled design matrix (Suh, 2001; Shin et al, 2004).

3.1 Independence Axiom

The functional requirements are defined as the minimum set of independent requirements that the design must satisfy. A set of functional requirements is the description of design goals. The independence axiom states that when there are two or more functional requirements, the design solution must be such that each one of them can be satisfied without affecting the others. That means a correct set of design parameters have to be chosen to satisfy the functional requirements and maintain their independence (Suh, 2001).

After the functional requirements are established, the next step in the design process is the conceptualization, which occurs during the mapping process going from the functional domain to the physical domain. To go from "what" to "how" requires mapping that involves creative conceptual work. After the overall design concept is generated by mapping, the design parameters must be identified and the mapping process must be completed (Suh, 2001).

The mapping process between the domains can be expressed mathematically in terms of the characteristic vectors that define design goals and design solutions. At a given level of the design hierarchy, the set of functional requirements that defines the specific design goals constitutes the functional requirement vector in the functional domain. Similarly, the set of design parameters in the physical domain that has been chosen to satisfy the functional requirements constitutes the design parameter vector. The relationship between these two vectors is shown in equation 3.1:

$$\{FR\} = [A] \bullet \{DP\} \qquad \textbf{(3.1)}$$

Equation 3.1 is a design equation for the design of a product, where [*A*] is called the design matrix that characterizes the product design. The design matrix is of the following form for a design that has three functional requirements and three design parameters (equation 3.2).

$$[A] = \begin{bmatrix} a11 & a12 & a13 \\ a21 & a22 & a23 \\ a31 & a32 & a33 \end{bmatrix} \quad \textbf{(3.2)}$$

To satisfy the independence axiom, the design matrix must be either diagonal or triangular (Suh, 2001). When the design matrix [*A*] is diagonal, each of functional requirements can be satisfied independently by means of one design parameter, where design is called as uncoupled design. When the matrix is triangular, the independence of functional requirements can be guaranteed if and only if the design parameters are determined in a proper sequence, where design is called as decoupled design. Any other form of the design matrix is called a full matrix and results in a coupled design. Therefore, when several functional requirements must be satisfied, designs must be developed that will enable to create either a diagonal or a triangular design matrix.

3.2 Information Axiom

Even for the same task defined by a given set of functional requirements, it is likely that different designers will come up with different designs, all of which may be acceptable in terms of the independence axiom. Indeed, there can be many designs that satisfy a given set of functional requirements. However, one of these designs is likely to be superior. The information axiom provides a quantitative measure of the merits of a given design, and thus it is useful in selecting the best among those designs that are acceptable (Suh, 2001). In addition, the information axiom provides the theoretical basis for design optimization and robust design.

Among the designs that are equally acceptable from the functional point of view, one of these designs may be superior to others in terms of the probability of achieving the design goals as expressed by the functional requirements. The information axiom states that the design with the highest probability of success is the best design.

3.3 Hierarchy and Zigzagging

Functional requirements and design parameters must be decomposed into a hierarchy until a complete detailed design is produced or until the design is completed (Suh, 2001). However, contrary to conventional wisdom on decomposition, they cannot be

decomposed by remaining in one domain. One must zigzag between the domains to be able to decompose the functional requirements and design parameters. Through this zigzagging, hierarchies are created in each design domain.

To decompose functional requirement and design parameter characteristic vectors, zigzagging must be employed between the domains. That is, it starts out in the "what" domain and go to the "how" domain. From a functional requirement in the functional domain, designer goes to the physical domain to conceptualize a design and determines its corresponding design parameter. Then designer comes back to the functional domain to create sub-level functional requirements that collectively satisfies the highest-level functional requirement. Then designer goes to the physical domain to find the corresponding sub-level design parameters by conceptualizing a design at this level. This process of decomposition is pursued until the functional requirement can be satisfied without further decomposition when all of the branches reach the final state.

4. INNOVATION MANAGEMENT FRAMEWORK

4.1 System Approach to Innovation Management

General systems theory (GST) integrates a broad range of special system theories by naming and identifying patterns and processes common to all of them (Skyttner, 1996). Von Bertalanffy (1991), one of the important figures in GST, defines the concept of system as follows:

"A complex of elements in mutual interaction… Each individual part… depends not only on conditions within itself, but also to a greater or lesser extent on the conditions within the whole, or within superordinate units of which it is a part".

From the perspective of GST, a system is an organized collection of parts or elements that are highly interrelated to accomplish an overall goal. Ackoff (1981) defines a system as a set of two or more elements that satisfies the following three conditions:

- The behavior of each element has an effect on the behavior of the whole.
- The behavior of the elements and their effects on the whole are interdependent.
- However, subgroups of the elements are formed, all have an effect on the behavior of the whole but none has an independent effect on it.

In terms of organizational management, a system is the organized collection of all resources that are highly interrelated to accomplish the organization's goal. As the environmental relationships and resource acquisition become the general concern, it is necessary to regard organization as an open system and try to apply systems thinking methodology to organizational innovation as systems thinking methodology is feasible to deal with the complex and dynamic relationships between the internal and external factors of the organization (Zhang and Jiang, 2008).

Organization can be considered as an organism, consisting of technical subsystem, structural subsystem, social and psychological subsystem, goal and values

subsystem, and interrelationships with the actors in environment such as customers, suppliers and competitors (Yan and Xiaolin, 2007). All these subsystems interrelate and interact with each other to form a complete and holistic system. Organizations collect required resources such as human, finance, material, knowledge and information from the external environment as input, perform transformational operations, and produce products and services as output. In the process from input to output, organization aims to achieve its own survival and development (Zhang and Jiang, 2008).

From the GST perspective, innovative organization can be considered as an open system that interacts with the external environment, based on available resources and internal environment by changes and transformation with the aim of providing innovative solutions in order to create value for customers and achieve organization's strategy or goals.

Kast and Rosenzweig (1972) have identified several key concepts of GST, and some of them that are particularly noteworthy are explained briefly and studied in terms of organization-wide innovation management system as follows:

- *Open to environment*: The environment of the system can include elements which cannot be viewed as part of the system but which do influence elements seen as belonging to the system (ten Haaf et al., 2002). Open systems can interact with their environment trading inputs to produce outputs (Kast and Rosenzweig, 1972).

  An innovative organization can be considered like a biological organism that interrelates to the environmental actors such as customers, suppliers and competitors. In terms of organization-wide innovation management, open to environment concept is very important in monitoring changes in environment to determine strategies against these changes and cooperating with actors in environment to meet the overall goal.

- *Purpose*: System has an overall purpose for existence (Kast and Rosenzweig, 1972). In terms of organizational management, many companies define their missions by emphasizing the overall goals they focus. The vision and strategies of an organization are the directives that guide all parts of the organization into the same goals.

Innovative organization defines its mission and strategies to present highly valuable innovations in order to keep its survivability. It outlines a vision for innovation that describes the importance of innovation to the organization in achieving its business vision and this relationship should be clearly articulated.

- *Interrelated subsystems*: System is a collection of its subsystems, which are worked together for the purpose of the system. The system cannot be divided into independent subsets; it is more than the sum of its parts (Blanchard and Fabrycky, 1990). This reason of this situation is the interdependence between the subsystems (Kast and Rosenzweig, 1972).

  Innovative organization can be viewed as comprising of many interrelated components, such as departments, programs, divisions, teams, etc. Each of these subsystems has a way of doing things to, along with other subsystems, achieve the overall goals of the innovative organization.

- *Transformation process*: The system has various inputs; some goes through certain processes to produce certain outputs, and some accomplishes the overall desired goal for the system (Kast and Rosenzweig, 1972). In terms of organizational management, companies acquire inputs such as raw materials and labor from the environment, transform them into goods and services, and deliver these outputs to customers.

  Innovative organization includes a well-designed innovation process that receives required inputs from various sources and performs essential transformation operations in order to produce highly valuable innovations.

- *Feedback*: Feedback is a mechanism that allows a system to attain the desired or steady state; it is used to evaluate and monitor the system in order to guide it to more effective way for overall goal (Kast and Rosenzweig, 1972). For an organization, feedback comes from internal sources, e.g., employees and external sources, e.g., customers, suppliers.

  In terms of innovation management, feedback is an important mechanism to perform innovation operations more effective by providing information about innovation activities. Feedbacks collected from a variety of sources involve valuable information that can be used as inputs for the innovation process.

- *Homeostasis*: Homeostasis refers to the ability of system to achieve a state of dynamic equilibrium that ensures system to return to a state that maximizes its chances of survival and growth (Kast and Rosenzweig, 1972). If any of the parts or activities in the system seems weakened or misaligned, the system makes necessary adjustments to achieve its goals more effectively.

  From the perspective of innovation management, the concept of homeostasis refers to seeking the improved state rather than steady equilibrium. Continuous improvement rather than maintenance of status quo is a key issue to become an innovative organization. Innovative organization continually scans the environment and improves its operations in order to keep survivability.

4.2 Axiomatic Design Domains for Framework Components

The key concepts of organization-wide innovation management have been identified by using general system approach. At this point, axiomatic design (AD) domains are studied to determine the core components of the framework and to decompose them into sub-components, with the aim of designing the framework for organization-wide innovation management.

4.2.1 Customer Domain

Companies must find new ways to differentiate from the competitive environment; they need to continuously anticipate customer needs, generate attractive ideas, and transfer them into successful products, processes, services and business models. Innovation is widely recognized as critical source and driver for company's survival by facilitating to penetrate new markets, to spread out the existing market share and to provide the company an increased competitive advantage. As stated by Dooley and Sullivan (2003), becoming an innovative organization is a means to compete and keep survivability in dynamic and changing business environment. In this aspect, companies require a comprehensive and integrated approach to manage innovation activities with the aim to maximize effectiveness and efficiency while focusing on the generation of sustainable value.

In the light of companies' expectations that are willing to create value through successful innovations and improve their innovation competencies continuously, the framework for organization-wide innovation management should be designed in order to meet the needs of;

- increasing the effectiveness of the innovation investments,
- increasing the development efficiency to offer innovative solutions,
- decreasing the time-to-market of innovations to lead the competition, and
- achieving continuous improvement to serve always better.

Through an extensive review of literature, common points of successful innovative organizations have been identified as follows:

- Successful innovation is strategy-based.
- Successful innovation depends on effective internal and external linkages.
- Successful innovation requires enabling mechanisms for making change happen.
- Successful innovation only happens within a supporting organizational context.

Companies' expectations from innovation management and common points of successful innovative organizations should be taken into consideration while designing the framework for organization-wide innovation management.

4.2.2 Functional Domain and Physical Domain

According to axiomatic design (AD) methodology, design is described as the creation of synthesized solutions in the form of products, processes or systems that satisfy perceived needs through mapping between functional requirements (FRs) and design parameters (DPs).

With the intention of designing the framework for organization-wide innovation management system, the main functional requirement is to become an organization capable of managing innovation activities systematically and improving innovation competency continuously in holistic and sustainable manner. On the purpose of

achievement of this main functional requirement, the main design parameter is expressed with the name of ‘innovation oriented organization’.

In order to determine the core functionalities of the framework of innovation oriented organization, first level FRs have been identified through the zigzagging feature of AD methodology; first level FRs of the framework have been introduced by querying the core functionalities of innovation oriented organization. With the aim of decomposition of main functional requirement and design parameter, key concepts of innovation management from the system approach perspective and companies’ expectations from innovation management have been taken into consideration.

As described in section 4.1 (System Approach to Innovation Management) in detail, general system approach provides several key concepts which should be considered while defining a system for organization-wide innovation management. These concepts have been interpreted in terms of innovation oriented organization (IOO). IOO should have an innovation oriented mission, and a well-defined transformational process to produce successful innovations. IOO should be consisted of several interrelated subsystems with the aim of supporting the organization's overall goal. In addition, organizational characteristics are important aspects for IOO to enable and promote continuous innovation throughout the organization. From the open system perspective, IOO should monitor changes in environment to determine its strategies, and cooperate with environmental actors to meet the overall goal collectively.

Companies’ expectations from innovation management system have been described in section 4.2.1 (Customer Domain) in detail. These expectations should be taken as guidance to design the framework of innovation oriented organization. In order to meet the need of companies that are willing to become an innovation oriented organization, the framework should have an innovation oriented strategy, build an innovation-friendly organizational context, enable supportive mechanisms for making change happen, and manage its internal and external linkages effectively.

In the light of the findings obtained through general system approach and customer domain analysis, functional requirements and design parameters have been defined for the framework of innovation oriented organization. Table 4.1 shows these FRs associated with their corresponding DPs.

Table 4.1: First level functional requirements and design parameters

Functional Requirements	Design Parameters
FR1: Organize innovation development activities systematically	DP1: Innovation Process
FR2: Transform the organization into an innovation-friendly organization	DP2: Organizational Infrastructure
FR3: Facilitate innovation by performing supportive operations	DP3: Supportive Systems
FR4: Manage innovation-oriented interactions with environment	DP4: Environmental Relations

The decomposition of the FRs is collectively exhaustive; the four functions together correspond the functional requirements of framework at level one. They are also mutually exclusive and distinct. This means that the framework of innovation oriented organization is consistent with the axioms of AD methodology, at level one.

Based on the relationships between first level functional requirements, the design matrix of first level FR and DP decomposition is in triangular form that points out decoupled design (Equation 4.1). It means that independence axiom is satisfied, but the independence of FRs is guaranteed if and only if the DPs are determined in a proper sequence.

$$\begin{bmatrix} FR1 \\ FR2 \\ FR3 \\ FR4 \end{bmatrix} = \begin{bmatrix} X & & & \\ X & X & & \\ X & X & X & \\ X & X & X & X \end{bmatrix} \begin{bmatrix} DP1 \\ DP2 \\ DP3 \\ DP4 \end{bmatrix} \quad \textbf{(4.3)}$$

The design matrix of first level FR and DP decomposition introduces important information about how to build an innovation oriented organization. Firstly, innovation process should be organized in a systematic manner. Secondly, organizational infrastructure should be designed in the form to promote innovation. Then, supportive systems should be built in order to facilitate the innovation process. Lastly, environmental relations should be formed and managed for innovation-oriented interactions. Each of these components has its own set of FRs and DPs, which are explored in the following decomposition sections.

In the light of the findings of first level decomposition, an organization is named as innovation oriented organization if it has a well-defined innovation process, operates in an innovation-friendly organizational infrastructure, performs supportive operations to facilitate innovation activities, and develops innovation-oriented relations with environmental actors.

4.2.2.1 FR1 – DP1 Decomposition

Innovation process (DP1) is required to organize innovation development activities in systematic manner (FR1). With the aim of designing the innovation process for innovation oriented organization, decomposition of FR1 and DP1 is as follows:

FR1: Organize innovation development activities in systematic manner

FR11: Organize idea development activities in systematic manner

FR12: Organize solution development activities in systematic manner

FR13: Organize improvement activities for innovation process

DP1: Innovation process

DP11: Idea development phase

DP12: Solution development phase

DP13: Process improvement phase

Organizing innovation development activities in systematic manner (FR1) consists of three main phases: organization of idea development activities systematically (FR11), organization of solution development activities systematically (FR12), and organization of process improvement activities (FR13). In order to meet these functional requirements, main phases of innovation process (DP1) are defined as design parameters. Idea development phase (DP11) is required to organize idea development activities in systematic manner (FR11). Solution development phase (DP12) covers the need of organizing solution development activities systematically (FR12) after the organization of idea development activities are performed successfully (FR11). Through the process improvement phase (DP13), organizing improvement activities for innovation process (FR13) is essential to enhance the overall process including idea development phase (DP11) and solution development phase (DP12).

The design matrix of these functional requirements and design parameters are shown in equation 4.2. The design matrix is in triangular form, which points out decoupled design. It means that independence axiom is satisfied, but the independence of FRs is guaranteed if and only if the DPs are determined in a proper sequence.

$$\begin{bmatrix} FR11 \\ FR12 \\ FR13 \end{bmatrix} = \begin{bmatrix} x & & \\ x & x & \\ x & x & x \end{bmatrix} \begin{bmatrix} DP11 \\ DP12 \\ DP13 \end{bmatrix} \quad \textbf{(4.2)}$$

4.2.2.1.1. FR11 – DP11 Decomposition

Idea development phase (DP11) is required to organize idea development activities in systematic manner (FR11). With the aim of designing the idea development phase of innovation process for innovation oriented organization, decomposition of FR11 and DP11 is as follows:

FR11: Organize idea development activities in systematic manner

FR111: Collect innovative ideas from different sources and evaluate them

FR112: Conceptualize projects from promoted ideas and analyze feasibility

DP11: Idea development phase

DP111: Idea generation and evaluation stage

DP112: Project definition and feasibility stage

Organizing idea development activities in systematic manner (FR11) consists of two functional requirements: collecting innovative ideas from different sources and evaluating them strategically (FR111), and conceptualizing projects from promoted ideas and analyzing their feasibility (FR112). In order to meet these functional requirements, the stages of idea development phase (DP11) are specified as design parameters. Idea generation and evaluation stage (DP111) is designated to collect innovative ideas from different sources and evaluate them strategically (FR111). Concept definition and feasibility stage (DP112) covers the need of conceptualizing projects from promoted ideas and analyzing their feasibility (FR112), after the evaluation of collected ideas from the strategic perspective (FR111).

The design matrix of these functional requirements and design parameters are shown in equation 4.3. The design matrix is in triangular form, which points out decoupled

design. It means that independence axiom is satisfied, but the independence of FRs is guaranteed if and only if the DPs are determined in a proper sequence.

$$\begin{bmatrix} FR111 \\ FR112 \end{bmatrix} = \begin{bmatrix} x & \\ x & x \end{bmatrix} \begin{bmatrix} DP111 \\ DP112 \end{bmatrix} \quad \textbf{(4.3)}$$

4.2.2.1.2. FR12 – DP12 Decomposition

Solution development phase (DP12) is required to organize solution development activities in systematic manner (FR12). With the aim of designing the solution development phase of innovation process for innovation oriented organization, decomposition of FR12 and DP12 is as follows:

FR12: Organize solution development activities in systematic manner

FR121: Design, implement and test innovative solution as conceptualized

FR122: Introduce innovative solution to customers in the right way

DP12: Solution development phase

DP121: Solution implementation stage

DP122: Solution launch stage

Organizing solution development activities in systematic manner (FR12) consists of two functional requirements: designing, implementing and testing innovative solution as conceptualized (FR121), and introducing innovative solution to customers in the right way (FR122). In order to meet these functional requirements, the stages of solution development phase (DP12) are specified as design parameters. Solution implementation stage (DP121) is designated to design, implement and test innovative solution as conceptualized (FR121). Solution launch stage (DP122) covers the need of introducing innovative solution to customers in the right way (FR122), after the completion of implementing innovative solution successfully (FR121).

The design matrix of these functional requirements and design parameters are shown in equation 4.4. The design matrix is in triangular form, which points out decoupled design. It means that independence axiom is satisfied, but the independence of FRs is guaranteed if and only if the DPs are determined in a proper sequence.

$$\begin{bmatrix} FR121 \\ FR122 \end{bmatrix} = \begin{bmatrix} x & \\ x & x \end{bmatrix} \begin{bmatrix} DP121 \\ DP122 \end{bmatrix} \quad \textbf{(4.4)}$$

4.2.2.1.3. FR13 – DP13 Decomposition

Process improvement phase (DP13) is required to organize improvement activities for innovation process (FR13). With the aim of designing the process improvement phase of innovation process for innovation oriented organization, decomposition of FR13 and DP13 is as follows:

FR13: Organize improvement activities for innovation process

FR131: Assess customer feedback on innovative solution offered

FR132: Learn from experience obtained during innovation process

DP13: Process improvement phase

DP131: Feedback analysis stage

DP132: Continuous learning stage

Organizing improvement activities for innovation process (FR13) consists of two functional requirements: assessing customer feedback on innovative solution offered (FR131), and learning from experience obtained during innovation process (FR132). In order to meet these functional requirements, the stages of process improvement phase (DP13) are specified as design parameters. Feedback analysis stage (DP131) is designated to assess customer feedback on innovative solution offered (FR131). Continuous learning stage (DP132) covers the need of learning from experience obtained during innovation process (FR132).

The design matrix of these functional requirements and design parameters are shown in equation 4.5. The design matrix is in triangular form, which points out decoupled design. It means that independence axiom is satisfied, but the independence of FRs is guaranteed if and only if the DPs are determined in a proper sequence.

$$\begin{bmatrix} FR131 \\ FR132 \end{bmatrix} = \begin{bmatrix} x & \\ x & x \end{bmatrix} \begin{bmatrix} DP131 \\ DP132 \end{bmatrix} \quad \textbf{(4.5)}$$

4.2.2.1.4. Summary of FR1 – DP1 Decomposition

Decomposition of organizing innovation development activities in systematic manner (FR1) and innovation process (DP1) is summarized in Table 4.2.

Table 4.2: Decomposition of FR1 and DP1

Functional Requirements	Design Parameters
FR1: Organize innovation development activities in systematic manner	DP1: Innovation process
FR11: Organize idea development activities in systematic manner	DP11: Idea development phase
FR111: Collect innovative ideas from different sources and evaluate them	DP111: Idea generation and evaluation
FR112: Conceptualize projects from promoted ideas and analyze feasibility	DP112: Project definition and feasibility
FR12: Organize solution development activities in systematic manner	DP12: Solution development phase
FR121: Design, implement and test innovative solution as conceptualized	DP121: Solution implementation
FR122: Introduce innovative solution to customers in the right way	DP122: Solution launch
FR13: Organize improvement activities for innovation process	DP13: Process improvement phase
FR131: Assess customer feedback on innovative solution offered	DP131: Feedback analysis
FR132: Learn from experience obtained during innovation process	DP132: Continuous learning

4.2.2.2 FR2 – DP2 Decomposition

Organizational infrastructure (DP2) is required to transform the organization into an innovation-friendly organization (FR2). With the aim of designing the organizational infrastructure for innovation oriented organization, decomposition of FR2 and DP2 is as follows:

FR2: Transform the organization into an innovation-friendly organization

FR21: Enable innovation throughout the organization by means of formal structuring

FR22: Promote innovation throughout the organization by means of informal structuring

DP2: Organizational infrastructure

DP21: Formal organizational dimension

DP22: Informal organizational dimension

Transforming the organization into an innovation-friendly organization (FR2) consists of two functional requirements: enabling innovation throughout the organization by means of formal structuring (FR21), and promoting innovation throughout the organization by means of informal structuring (FR22). In order to meet these functional requirements, main dimensions of organizational infrastructure (DP2) are specified as design parameters. Formal organizational dimension (DP21) is required to enable innovation throughout the organization by means of formal structuring (FR21). Informal organizational dimension (DP22) covers the need of promoting innovation throughout the organization by means of informal structuring (FR22), after formal organizational dimension is built successfully (FR21).

The design matrix of these functional requirements and design parameters are shown in equation 4.6. The design matrix is in triangular form, which points out decoupled design. It means that independence axiom is satisfied, but the independence of FRs is guaranteed if and only if the DPs are determined in a proper sequence.

$$\begin{bmatrix} FR21 \\ FR22 \end{bmatrix} = \begin{bmatrix} x & \\ x & x \end{bmatrix} \begin{bmatrix} DP21 \\ DP22 \end{bmatrix} \quad \textbf{(4.6)}$$

4.2.2.2.1. FR21 – DP21 Decomposition

Formal organizational dimension (DP21) is required to enable innovation throughout the organization by means of formal structuring (FR21). With the aim of designing the formal dimension of organizational infrastructure for innovation oriented organization, decomposition of FR21 and DP21 is as follows:

FR21: Enable innovation throughout the organization by means of formal structuring

FR211: Lead the whole organization towards the way of innovation

FR212: Foster and accelerate innovation activities throughout organization

FR213: Define enabling roles and figures for innovation activities

DP21: Formal organizational dimension

DP211: Vision and strategy

DP212: Organization structure

DP213: Key individuals

Enabling innovation throughout the organization by means of formal structuring (FR21) consists of three functional requirements: leading the whole organization towards the way of innovation (FR211), fostering and accelerating innovation activities throughout organization (FR212), and defining enabling roles and figures for innovation activities (FR213). In order to meet these functional requirements, the components of formal organizational dimension (DP21) are specified as design parameters. Vision and strategy (DP211) is required to lead the whole organization towards the way of innovation (FR211). Organization structure (DP212) covers the need of foster and accelerating innovation activities throughout organization (FR212) in lights of corporate vision and strategy (FR211). After organization structure is formed, key individuals (DP213) are considered to define enabling roles and figures for innovation activities (FR213).

The design matrix of these functional requirements and design parameters are shown in equation 4.7. The design matrix is in triangular form, which points out decoupled design. It means that independence axiom is satisfied, but the independence of FRs is guaranteed if and only if the DPs are determined in a proper sequence.

$$\begin{bmatrix} FR211 \\ FR212 \\ FR213 \end{bmatrix} = \begin{bmatrix} x & & \\ x & x & \\ x & x & x \end{bmatrix} \begin{bmatrix} DP211 \\ DP212 \\ DP213 \end{bmatrix} \quad \textbf{(4.7)}$$

4.2.2.2.2. FR22 – DP22 Decomposition

Informal organizational dimension (DP22) is required to promote innovation throughout organization by means of informal structuring (FR22). With the aim of designing the informal dimension of organizational infrastructure for innovation oriented organization, decomposition of FR22 and DP22 is as follows:

FR22: Promote innovation throughout organization by means of informal structuring

FR221: Enable innovation awareness spread throughout the organization

FR222: Ingrain innovation concept into the corporate culture

FR223: Design the work climate to promote creativity and innovation

DP22: Informal organizational dimension

DP221: Top management influence

DP222: Innovation culture

DP223: Innovation climate

Promoting innovation throughout organization by means of informal structuring (FR22) consists of three functional requirements: enabling innovation awareness spread throughout the organization (FR221), ingraining innovation concept into the corporate culture (FR222), and designing the work climate to promote creativity and innovation (FR223). In order to meet these functional requirements, the components of informal organizational dimension (DP22) are specified as design parameters. Top management influence (DP221) is required to enable innovation awareness spread throughout the organization (FR221). Innovation culture (DP222) covers the need of ingraining innovation concept into the corporate culture (FR222) with the support of top management influence (FR221). In order to design the work climate to promote creativity and innovation (FR223) through innovation climate (DP223), top management influence (FR221) and innovation culture (FR222) are preconditions.

The design matrix of these functional requirements and design parameters are shown in equation 4.8. The design matrix is in triangular form, which points out decoupled design. It means that independence axiom is satisfied, but the independence of FRs is guaranteed if and only if the DPs are determined in a proper sequence.

$$\begin{bmatrix} FR221 \\ FR222 \\ FR223 \end{bmatrix} = \begin{bmatrix} x & & \\ x & x & \\ x & x & x \end{bmatrix} \begin{bmatrix} DP221 \\ DP222 \\ DP223 \end{bmatrix} \quad \textbf{(4.8)}$$

4.2.2.2.3. Summary of FR2 – DP2 Decomposition

Decomposition of transforming the organization into an innovation-friendly organization (FR2) and organizational infrastructure (DP2) is summarized in Table 4.3.

Table 4.3: Decomposition of FR2 and DP2

Functional Requirements	Design Parameters
FR2: Transform the organization into innovation-friendly organization	DP2: Organizational infrastructure
FR21: Enable innovation throughout organization by means of formal dimension	DP21: Formal organization dimension
FR211: Lead the whole organization towards the way of innovation	DP211: Vision and strategy
FR212: Foster and accelerate innovation activities throughout organization	DP212: Organization structure
FR213: Define enabling roles and figures for innovation activities	DP213: Key individuals
FR22: Promote innovation throughout organization by means of informal dimension	DP22: Informal organization dimension
FR221: Enable innovation awareness spread throughout the organization	DP221: Top management influence
FR222: Ingrain innovation concept into the corporate culture	DP222: Innovation culture
FR223: Design the work climate to promote creativity and innovation	DP223: Innovation climate

4.2.2.3 FR3 – DP3 Decomposition

Supportive systems (DP3) are required to facilitate innovation by performing supportive operations (FR3). With the aim of designing the supportive systems for innovation oriented organization, decomposition of FR3 and DP3 is as follows:

FR3: Facilitate innovation by performing supportive operations

FR31: Utilize technology to support and facilitate innovation activities

FR32: Manage human resources with innovation-oriented objective

FR33: Manage knowledge assets with innovation-oriented objective

DP3: Supportive systems

DP31: Information technologies

DP32: Human resource management system

DP33: Knowledge management system

Facilitating innovation by performing supportive operations (FR3) consists of three functional requirements: utilizing the technology to support and facilitate innovation activities (FR31), managing human resources with innovation-oriented objective (FR32), and managing knowledge assets with innovation-oriented objective (FR33). In order to meet these functional requirements, main components of supportive systems (DP3) are specified as design parameters. Information technologies (DP31) is required to utilize the technology to support and facilitate innovation activities (FR31). Human resource management system (DP32) covers the need of managing human resources with innovation-oriented objective (FR32), by means of utilizing information technologies (FR31). Managing knowledge assets with innovation-oriented objective (FR33) is accomplished through knowledge management system (DP33), by means of utilizing information technologies (FR31).

The design matrix of these functional requirements and design parameters are shown in equation 4.9. The design matrix is in triangular form, which points out decoupled design. It means that independence axiom is satisfied, but the independence of FRs is guaranteed if and only if the DPs are determined in a proper sequence. For this case, information technologies should be accomplished before implementing human resource management system and knowledge management system.

$$\begin{bmatrix} FR31 \\ FR32 \\ FR33 \end{bmatrix} = \begin{bmatrix} x & & \\ x & x & \\ x & & x \end{bmatrix} \begin{bmatrix} DP31 \\ DP32 \\ DP33 \end{bmatrix} \quad \textbf{(4.9)}$$

4.2.2.3.1. FR32 – DP32 Decomposition

Human resource management system (DP32) is required to manage human resources with innovation-oriented objective (FR32). With the aim of designing the human resource management system for innovation oriented organization, decomposition of FR32 and DP32 is as follows:

FR32: Manage human resources with innovation-oriented objective

FR321: Hire qualified employees and build company loyalty

FR322: Develop employee competence for required skills

FR323: Encourage employees to contribute innovation activities

DP32: Human resource management system

DP321: Selection and satisfaction program

DP322: Competency management

DP323: Rewarding system

Managing human resources with innovation-oriented objective (FR32) consists of three functional requirements: hiring qualified employees and building company loyalty (FR321), developing employee competence for required skills (FR322), and encouraging employees to contribute innovation activities (FR323). In order to meet these functional requirements, the components of human resource management system (DP32) are specified as design parameters. After hiring qualified employees and building company loyalty (FR321) by means of selection and satisfaction program (DP321), competency management (DP322) covers the need of developing employee competence for required skills (FR322) and rewarding system (DP323) covers the requirement of encouraging employees to contribute innovation activities (FR323).

The design matrix of these functional requirements and design parameters are shown in equation 4.10. The design matrix is in triangular form, which points out decoupled design. It means that independence axiom is satisfied, but the independence of FRs is guaranteed if and only if the DPs are determined in a proper sequence. For this case, selection and satisfaction program should be established before implementing competency management and rewarding system.

$$\begin{bmatrix} FR321 \\ FR322 \\ FR323 \end{bmatrix} = \begin{bmatrix} x & & \\ x & x & \\ x & & x \end{bmatrix} \begin{bmatrix} DP321 \\ DP322 \\ DP323 \end{bmatrix} \quad \textbf{(4.10)}$$

4.2.2.3.2. FR33 – DP33 Decomposition

Knowledge management system (DP33) is required to manage knowledge assets with innovation-oriented objective (FR33). With the aim of designing the knowledge management system for innovation oriented organization, decomposition of FR33 and DP33 is as follows:

FR33: Manage knowledge assets with innovation-oriented objective

FR331: Obtain knowledge in the boundaries of the organization

FR332: Make knowledge accessible to all employees

DP33: Knowledge management system

DP331: Knowledge creation and acquisition

DP332: Knowledge diffusion

Managing knowledge assets with innovation-oriented objective (FR33) consists of two functional requirements: obtaining knowledge in the boundaries of the organization (FR331), and making knowledge accessible to all employees (FR332). In order to meet these functional requirements, the components of knowledge management system (DP33) are specified as design parameters. Knowledge creation and acquisition (DP331) is required to obtain knowledge in the boundaries of the organization (FR331). After creating knowledge internally or acquiring it externally (FR331), knowledge is made accessible to all employees (FR332) through knowledge diffusion (DP332).

The design matrix of these functional requirements and design parameters are shown in equation 4.11. The design matrix is in triangular form, which points out decoupled design. It means that independence axiom is satisfied, but the independence of FRs is guaranteed if and only if the DPs are determined in a proper sequence.

$$\begin{bmatrix} FR331 \\ FR332 \end{bmatrix} = \begin{bmatrix} x & \\ x & x \end{bmatrix} \begin{bmatrix} DP331 \\ DP332 \end{bmatrix} \quad \textbf{(4.11)}$$

4.2.2.3.3. Summary of FR3 – DP3 Decomposition

Decomposition of facilitating innovation by performing supportive operations (FR3) and supportive systems (DP3) is summarized in Table 4.4.

Table 4.4: Decomposition of FR3 and DP3

Functional Requirements	Design Parameters
FR3: Facilitate innovation by performing supportive operations	DP3: Supportive systems
FR31: Utilize technology to support and facilitate innovation activities	DP31: Information technologies
FR32: Manage human resources with innovation-oriented objective	DP32: Human resource management system
FR321: Hire qualified employees and build company loyalty	DP321: Selection & satisfaction program
FR322: Develop employee competence for required skills	DP322: Competency management
FR323: Encourage employees to contribute innovation activities	DP323: Rewarding system
FR33: Manage knowledge assets with innovation-oriented objective	DP33: Knowledge management system
FR331: Obtain knowledge in the boundaries of the organization	DP331: Knowledge creation & acquisition
FR332: Make knowledge accessible to all employees	DP332: Knowledge diffusion

4.2.2.4 FR4 – DP4 Decomposition

Environmental relations (DP4) are required to manage innovation-oriented interactions with environment (FR4). With the aim of designing the environmental relations for innovation oriented organization, decomposition of FR4 and DP4 is as follows:

FR4: Manage innovation-oriented interactions with environment

FR41: Monitor changes and trends in the environment

FR42: Cooperate with environmental actors for innovation activities

DP4: Environmental relations

DP41: Environmental analysis

DP42: Co-innovation

Manage innovation-oriented interactions with environment (FR4) consists of two functional requirements: monitoring changes and trends in the environment (FR41)

and cooperating with environmental actors for innovation activities (FR42). In order to meet these functional requirements, main components of environmental relations (DP4) are specified as design parameters. Environmental analysis (DP41) is required to monitor the changes and trends in the environment (FR41). Co-innovation (DP42) covers the need of cooperating with the actors in the environment (FR42) based on the information collected through environmental analysis (DP41).

The design matrix of these functional requirements and design parameters are shown in equation 4.12. The design matrix is in triangular form, which points out decoupled design. It means that independence axiom is satisfied, but the independence of FRs is guaranteed if and only if the DPs are determined in a proper sequence.

$$\begin{bmatrix} FR41 \\ FR42 \end{bmatrix} = \begin{bmatrix} x & \\ x & x \end{bmatrix} \begin{bmatrix} DP41 \\ DP42 \end{bmatrix} \quad \textbf{(4.12)}$$

4.2.2.4.1. FR41 – DP41 Decomposition

Environmental analysis (DP41) is required to monitor the changes and trends in the environment (FR41). With the aim of designing the environmental analysis for innovation oriented organization, decomposition of FR41 and DP41 is as follows:

FR41: Monitor changes and trends in the environment

FR411: Monitor customer needs, market trends and competitor actions

FR412: Monitor economic, social, political and technological changes

DP41: Environmental analysis

DP411: Micro-environmental analysis

DP412: Macro-environmental analysis

Monitoring changes and trends in the environment (FR41) consists of two functional requirements: monitoring customer needs, market trends and competitor actions (FR411), and monitoring economic, social, political and technological changes (FR412). In order to meet these functional requirements, the levels of environmental analysis (DP41) are specified as design parameters. Monitoring customer needs, market trends and competitor actions (FR411) is accomplished through micro-environmental analysis (DP411). On the other hand, monitoring economic, social,

political and technological changes (FR412) is carried out through macro-environmental analysis (DP412).

The design matrix of these functional requirements and design parameters are shown in equation 4.13. The design matrix is in diagonal form, which points out uncoupled design. It means that independence axiom is satisfied without considering the proper sequence between design parameters.

$$\begin{bmatrix} FR411 \\ FR412 \end{bmatrix} = \begin{bmatrix} x & \\ & x \end{bmatrix} \begin{bmatrix} DP411 \\ DP412 \end{bmatrix} \quad \textbf{(4.13)}$$

4.2.2.4.2. FR42 – DP42 Decomposition

Co-innovation (DP42) is required to cooperate with environmental actors for innovation activities (FR42). With the aim of designing the co-innovation for innovation oriented organization, decomposition of FR42 and DP42 is as follows:

FR42: Cooperate with environmental actors for innovation activities

FR421: Integrate customers into the innovation process

FR422: Collaborate with external partners to innovate

DP42: Co-innovation

DP421: Customer involvement

DP422: Collaboration networks

Cooperating with environmental actors for innovation activities (FR42) consists of two functional requirements: integrating customers into the innovation process (FR421), and collaborating with external partners to innovate (FR422). In order to meet these functional requirements, the components of co-innovation (DP42) are specified as design parameters. Integrating customers into the innovation process (FR421) is carried out through customer involvement (DP421). On the other hand, collaborating with external partners to innovate (FR422) is accomplished through collaboration networks (DP422).

The design matrix of these functional requirements and design parameters are shown in equation 4.14. The design matrix is in diagonal form, which points out uncoupled design. It means that independence axiom is satisfied without considering the proper sequence between design parameters.

$$\begin{bmatrix} FR421 \\ FR422 \end{bmatrix} = \begin{bmatrix} x & \\ & x \end{bmatrix} \begin{bmatrix} DP421 \\ DP422 \end{bmatrix} \quad \textbf{(4.14)}$$

4.2.2.4.3. Summary of FR4 – DP4 Decomposition

Decomposition of managing innovation-oriented interactions with environment (FR4) and environmental relations (DP4) is summarized in Table 4.5.

Table 4.5: Decomposition of FR4 and DP4

Functional Requirements	Design Parameters
FR4: Manage innovation-oriented interactions with environment	DP4: Environmental relations
FR41: Monitor changes and trends in the environment	DP41: Environmental analysis
FR411: Monitor customer needs, market trends and competitor actions	DP411: Micro-environmental analysis
FR412: Monitor economic, social, political and technological changes	DP412: Macro-environmental analysis
FR42: Cooperate with environmental actors for innovation activities	DP42: Co-innovation
FR421: Integrate customers into the innovation process	DP421: Customer involvement
FR422: Collaborate with external partners to innovate	DP422: Collaboration networks

4.2.3 Process Domain

The process domain is the domain where the specifics of how the design parameters identified in the physical domain are implemented; it allocates the processes required to achieve the design parameters.

In this study, after design parameters of the framework are determined in physical domain, process variables could have been investigated in order to answer the question of how to realize the specified framework components. Implementation of the framework components is significantly important to carry out the design parameters while building the innovation oriented organization.

However, process variables have not been investigated in this study. The reason behind this situation is that this study mainly focuses on designing a framework for

organization-wide innovation management system. Therefore, investigation of functional requirements and design parameters is essential and sufficient to build the framework and its components. On the other hand, introduction of processes and steps for implementation of the framework components is not required for this study.

4.3 Explanation of Framework Components

Through an extensive review of literature, the framework of innovation oriented organization is developed by using general system approach to identify the key concepts of innovation management, and axiomatic design methodology to determine the core components of the framework and decompose them into sub-components. In summary of all relevant information and knowledge, innovation oriented organization can be defined as an organization which has a well-defined innovation process, operates in an innovation-friendly organizational infrastructure, performs supportive operations to facilitate innovation activities, and develops innovation-oriented relations with environmental actors.

Core components and subcomponents of the framework of innovation oriented organization are explained in order to depict the proposed framework more clearly.

4.3.1 Innovation Process

Successful innovation correlates strongly with how a company selects and manages projects, how it coordinates the inputs from various sources, how it links up with its customers. According to McCosh et al. (1998), an internal procedure is essential for keeping all innovation projects under continuous reconsideration, so that the work is done simultaneously on all fronts, but remains cohesive and compatible. Wynne (2006) addresses the need by expressing that innovation requires a systematic process that leads to an outcome. The innovation process is a gradual process of reducing uncertainty through a series of problem solving stages, moving through the phases of scanning and selecting and into implementation – linking market and technology-related streams along the way (Tidd et al., 2001).

Organizing innovation development activities and making them systematically is the foundation to build an innovation oriented organization. A well-designed innovation process helps business to identify, evaluate, develop, implement and exploit new solutions more efficiently and effectively. The systematic process from transforming

ideas to commercial outputs shapes an integrated flow to improve innovation, which is called as innovation value chain by Hansen and Birkinshaw (2007). Innovation oriented organization focuses on a systematic innovation process and perform strategic and operational activities regarding how it handles opportunities for innovative solutions.

The innovation process is divided into three main phases: idea development phase where organization focuses on what to offer, solution development phase where organization focuses on how to offer the innovative solution, and process improvement phase where organization focuses on how to improve the offered solution and the overall process. This approach is generally close to view of Ojasalo (2003) as he emphasizes that a new product development process consists of three phases: generating ideas, technical development, and commercializing.

4.3.1.1 Idea Development Phase

The process of innovation begins with picking up various kinds of ideas from inside or outside the organization. According to Tidd et al. (2001), these ideas are related to technology, markets, competitive behavior, shifts in the political or regulatory environment, new social trends, etc.

The goal of idea development phase is systematically organizing idea development activities such as idea collection from different sources, idea selection based on organization strategies, concept definition by using collected ideas, and evaluation of the concept. As stated by Koen et al. (2001), early stages of the innovation process include opportunity identification, opportunity analysis, idea genesis, idea selection and concept development. From the similar perspective, the idea development phase consists of two stages: ‘idea generation and evaluation stage’ and ‘project definition and feasibility stage’.

4.3.1.1.1. Idea Generation & Evaluation Stage

The most profitable new products will be those that meet the customer needs more effectively than competitors' products, therefore companies need to identify those needs, and then generate ideas and solutions to address them (McAdam and McClelland, 2002). Ideas are the main resources and starting point of innovation; formal and informal idea generation systems enhance the number and the quality of ideas (Koc and Ceylan, 2007). In addition, as stated by Cooper (1988), it is relatively

inexpensive to generate and screen ideas, yet this can have significant impact on ultimate success or failure.

Morris (1999) argues that idea generation based on an expansive view of knowledge creation is essentially grouping and integration of ideas from many sources of accepted knowledge. New ideas can come from various internal sources such as employees or external sources such as customers or suppliers. Innovation oriented organization builds idea channels and manages them effectively in order to collect the new ideas from various sources.

Idea evaluation means evaluation of the collected ideas based on company strategies in order to filter the compatible ideas. Guimaraes and Langley (1994) indicate that new ideas must be consistent with the company's goals. While innovation is mortally important for companies, any company that is inefficient in vetting new ideas or a company that continually introduces the wrong products consumes its own resources and fails (McAdam and McClelland, 2002).

4.3.1.1.2. Project Definition & Feasibility Stage

After collecting relevant trigger ideas from internal and external sources and making strategic decisions to pursue some of them, the next key phase is actually turning those potential ideas into some kind of reality; a new product or service, a change in process, a shift in business model (Bessant and Tidd, 2007).

The focus of this stage is to transform the promoted ideas into workable projects and evaluate these projects based on their feasibility. After defining the project from different combinations of various ideas, feasibility of the project is analyzed in order to investigate the requirements and potential impacts of the proposed concept. Preez and Louw (2008) indicate that the project feasibility is about collecting information, as well as modeling and prototyping in order to determine the feasibility. Technological and market researches are helpful tools to determine the possibility of innovation and the characteristics of demand for innovation.

4.3.1.2 Solution Development Phase

The goal of the solution development phase is systematically organizing solution development activities such as implementation of innovative solution and exploitation of the solution to the potential customers. Technical capabilities are important for the early stages of the innovation process and development activities,

while marketing capabilities are enormously significant for the launch stage (Calantone and di Benedetto, 1988).

Solution development phase consists of two critical stages to produce and introduce the innovative solution effectively in the right way and at the right time: solution implementation stage and solution launch stage.

4.3.1.2.1. Solution Implementation Stage

Preez and Louw (2008) express that design, prototyping and testing activities should be performed successfully in order to implement the innovative solution as conceptualized. The inputs of solution implementation stage are a clear strategic concept and some initial ideas for realizing the concept. On the other hand, the outputs are both a developed innovation and a prepared internal or external market, ready for final launch.

Implementing innovation project is very critical for achievement of innovation. Dealing with unexpected and unpredictable events and gradually bringing projects into being requires high levels of flexibility and creativity; in particular, it involves integrating knowledge sets from across organizational, functional and disciplinary boundaries (Tidd et al., 2001).

4.3.1.2.2. Solution Launch Stage

In parallel to technological aspects, innovation development is a process of identifying, exploring and preparing the market for launch of a new product or service. Tidd et al. (2001) emphasize that customer may not adopt innovation or continue its use over the long term even if the innovation is excellent. Similar to view of Adams et al. (2006), successful introduction of new products and services into markets is important for the survival and growth of an organization.

Solution launch stage includes commercialization process by introducing the innovative solution to market (Chakravorti, 2004). From this perspective, solution launch stage consists of the activities associated with preparing the market into which it will be launched. This is enormously essential since the whole innovation process is successfully completed only when the target market makes the decision to adopt the innovation. That is the reason of that marketing and commercialization strategies should be carefully performed to get innovative solution launched to market successfully.

4.3.1.3 Process Improvement Phase

An inevitable outcome of the launch of the innovative solution is the creation of new stimuli for restarting the cycle. If the product or service offering or process change fails, this offers valuable information about what to change for next time.

The goal of the process improvement phase is to design improvement activities for the offered innovative solution and the overall innovation process. With this aim of reviewing the completed project and attempting to capture learning from the experience, this phase includes two main activities to improve innovation process: feedback analysis and continuous learning.

4.3.1.3.1. Feedback Analysis Stage

Wisner and Corney (2001) argue that collecting and monitoring customer feedback allow companies to assess and upgrade their services and product capabilities as needed to maintain and improve competitiveness. Users are significant resources for innovation, and attentions paid to the dissatisfaction, solvents and super-standard demands that contain innovation information in user information would aid enterprises to find potential innovation opportunities in time (Yang Xue et al., 2007).

From the perspective of innovation oriented organization, innovation process does not end after the innovative solution is exploited to internal or external customers. Customer feedback collection and management provides very valuable information to enhance the innovation process.

4.3.1.3.2. Continuous Learning Stage

An organization's stock of knowledge is created, communicated and expanded through the continuous learning process (Larsen et al., 1991). As indicated by Hurley and Hult (1998), continuous learning enhances the capacity to innovate, which is the ability of the organization to adopt or implement new ideas, processes, or products successfully. Innovation oriented organization captures data, information and knowledge from the beginning of the innovation process and shared through the organization in order to be learned from mistakes. This is the way to improve future innovation initiatives.

Effective learning, in terms of both accumulating technological knowledge and knowledge about how to manage innovation process, requires a commitment to open

and informal review (Tidd et al., 2001). Guan and Ma (2003) suggest that learning culture should be promoted in an innovative organization.

4.3.2 Organizational Infrastructure

It has been widely demonstrated that the perceived work environment comprising both formal and informal elements does make a difference to the level of innovation in organizations (Amabile et al. 1996; Ekvall 1996). According to Thamhain (2005), the large number of successful commercialization of new product concepts provides clear evidence that these challenges can be met with the right organizational ambience.

Organizational infrastructure of innovation oriented organization needs to be designed in the way to enable innovation by considering both formal and informal dimensions. Management must facilitate the establishment of organizational conditions conducive to market-oriented innovation, consistent with the existing business dynamics and complexities (Tomkovich and Miller, 2000).

4.3.2.1 Formal Organizational Dimension

Formal structure refers to the organizational design illustrated in the organizational chart, such as hierarchical alignment, functional division, and management and employee roles, i.e. the hard component of organizational structure plus the formal relationship between individuals, groups and departments (Wang and Ahmed, 2002).

Building formal dimension of organization in the innovation oriented way is very critical to enable innovation throughout the organization.

4.3.2.1.1. Vision and Strategy

The corporate vision and strategy are the directives that guide all parts of the organization into the same goals. The main contribution of vision and strategy is to define the way to innovation. Innovation oriented organization outlines a vision that describes the importance of innovation to the organization in achieving its business vision and this relationship should be clearly articulated.

Ramanujam and Mensch (1985) define innovation strategy as a timed sequence of internally consistent and conditional resource allocation decisions that are designed to fulfill an organization’s objectives. Sundbo (1997) suggests that innovation activities must be consistent with an overarching organizational strategy that implies

that management must take conscious decisions regarding innovation goals. Innovation strategy is generally employed to describe the organization's innovation posture with regard to its competitive environment in terms of its new product and market development plans (Dyer and Song 1998).

The strategy functions as a guiding star for innovation. It can provide guidelines for the entrepreneurs concerning how innovative they should be, and what types of innovation they should develop. Management needs to clarify its innovation strategy and priorities in order to define where the company will focus its innovation efforts.

4.3.2.1.2. Organization Structure

Gold et al. (2001) define the organization structure as the rules, policies, procedures, processes, hierarchy of reporting relationships, and departmental boundaries that organize tasks within the firm. Building organization structure in the way to enable the change is strongly linked to success in innovation management.

Innovation is considered as an organization-wide task, involving production, marketing, administration, purchasing and many other functions; this provides strong pressure for widespread organization change towards more organic models. As stated by Tidd et al. (2001), the innovation success depends on having the ability to link these function groups together effectively in order to respond quickly to market signals; better coordination is associated with more flexible structures capable of rapid response.

4.3.2.1.3. Key Individuals

Due to the uncertainty and complexity caused from the nature of innovation, many promising inventions have potential risks to die before they make it to the outside world. According to Tidd et al. (2001), the way to decrease the risks is the presence of a key individual or a group of people who is prepared to support the innovation activities and to provide some motivation to enable the innovation through the organizational system. The presence of key enabling figures is an important element of innovation oriented organization.

Most organizations contain individuals who formally or informally promote innovation through their roles as ideators, inventers, technology gatekeepers, champions, sponsors and entrepreneurs. The recognition of these players within an

organization is an important step in facilitating innovation (Rosenfeld and Servo, 1990).

According to Tidd et al. (2001), there are several responsibilities that key individuals can take during the innovation activities. First, there is the source of critical technical knowledge; they have the breadth of understanding of the technology behind the innovation and the ability to solve the many development problems. The contribution is not only of technical knowledge; it also involves inspiration when particular technological problems appear insoluble; and it involves motivation and commitment.

4.3.2.2 Informal Organizational Dimension

Wang and Ahmed (2002) describe informal dimension of the organization as interpersonal, cross-functional and inter-organizational interaction that is not explicitly demonstrated in the organizational chart. As expressed by Quinn (1985), continuous innovation occurs largely because top managers appreciate innovation and manage their companies' value system and climate to support it.

Building informal dimension of organization in the innovation oriented way is very critical to enable the organization-wide innovation.

4.3.2.2.1. Innovation Culture

Barney (1986) defines organizational culture as a complex set of values, beliefs, assumptions, and symbols that define the way in which a firm conducts its business. From the organizational point of view, culture can be defined as the deeply seated values and beliefs shared by personnel in an organization.

It is important for organizations to provide a culture of democratic, lateral communication without the chains of hierarchy in order to attract and retain talented individuals who are so necessary for pursuing experimentation and innovation (Hamel, 1999). Innovation culture is an important determinant of sustained innovativeness by enabling to support and sustain innovative activities.

Successful innovation management requires the organizational culture encouraging to take risks and to accept failure as an opportunity for learning and development (Tidd et al., 2001). To create an innovation oriented culture and see innovation as

one of the corporate objectives, it is required that the culture must change to accommodate the risk of failure and uncertainty along with the focus on innovation.

4.3.2.2.2. Top Management Influence

Innovation oriented organization requires top management influence to enable innovation to spread through the organization. Top management team should foster innovation by creating a climate open to creativity and supportive of differences, and supportive of risk-taking (Howell and Avolio, 1993). The management team plays a critical role by inspiring, deciding on and restricting the innovation process.

It is a strong predictor for the realization of innovative ideas and management of organizational innovation (Lee and Chang, 2006) as innovation begins with top management considering organizational innovation as the way to survival. Tang (1999) exemplifies this situation by expressing that top management has to set directions, create values and establish expectations for the benefit of the company. According to McCosh et al. (1998), leaders in top management team must be supportive of innovation as a way of life, by their example, their words, and their actions.

Top management commitment is a common prescription associated with successful innovation; the challenge is to translate the concept into reality by funding mechanisms that demonstrate and reinforce the sense of management involvement, commitment, enthusiasm and support (Tidd et al., 2001).

4.3.2.2.3. Innovation Climate

Organizational climate is a set of properties of the work environment, perceived directly or indirectly by employees, that is assumed to be a major force in influencing employee behavior. It is generally accepted as individuals' perceptions of, or beliefs about, environmental factors shaping expectations about outcomes, contingencies, requirements, and interactions in the work environment (Hunter et. al. 2005).

Innovation requires a critical attitude and the courage to see problems, and an unconventional imagination in order to see solutions in a new way (Elgar, 2001). The organizational climate should be designed to promote the creativity and innovation; innovation oriented organization creates organizational conditions in which innovation can be encouraged or hampered (Tidd et al. 1997).

Innovative organization is organized in the way facilitating innovative practices rather than inhibiting them. In parallel to this expression, as stated by Patterson et al. (2005), the organizational climate is a key factor for explaining the innovation capacity of a company. According to Muffatto (1998), the creation of an innovative climate is needed to support innovation activities. In the implementation of innovation, companies have to create an innovation climate that fosters innovation by ensuring employee skills, providing incentives, and removing obstacles (Klein and Sorra, 1996).

4.3.3 Supportive Systems

Starbuck (1992) emphasizes that innovation arises at the intersection between flows of people and flows of knowledge. Therefore, innovation oriented organization needs to enhance knowledge assets, manages human resources and establishes the flow of information since these activities are enablers to increase the efficiency of innovation process.

4.3.3.1 Information Technologies

Tidd et al. (1997) state that knowledge and information flows are the key determinants of successful innovation and new product development processes. Therefore, information technologies plays a critical role in product development, as its allowance ranges from the transaction, storing, and processing of explicit knowledge to the facilitation of people networks, coordinated interfaces, and collaboration for the flowing of tacit knowledge (Van Den Brink, 2003).

Information technologies can help with collaboration, knowledge sharing, competitive intelligence, and in many other ways to help people generate ideas that are both creative and potentially valuable. As product development process is a knowledge intensive work, information technologies may be considered as an advanced tool that enhances the volume of data, information and knowledge that can be processed throughout the product development process (Nambisan, 2003).

Building on the understanding of the innovation process as a collaborative process, information technologies facilitate communication between individual actors (Sethi et al., 2003). Information technologies also help innovative organizations form innovation networks with their partners, suppliers and customers and thus engage in collaborative innovation-related activities at the innovation process.

Hamel (2002) emphasizes the role of information technology as an enabler not only of product or process innovation, but also of what he calls business concept innovation.

4.3.3.2 Human Resource Management

Human resources can be seen as a strategic lever in creating competitive advantage through the value of the knowledge, skills and training (Becker and Gerhart, 1996). According to Scarbrough (2003), human resource management function plays a crucial role in nurturing the necessary conditions for catalyzing and channeling individuals towards the development of innovation activities.

Human resource practices are the primary means by which companies can influence and shape the skills, attitudes, and behavior of individuals to do their work and thus achieve organizational goals (Collins and Clark, 2003). Companies can use some strategic human resources practices, such as staffing, training, participation, performance appraisal, and compensation, as means to motivate employees' commitment and get them involved in creative thinking and innovation (Damanpour, 1991; Laursen and Foss, 2003).

An internally consistent human resource system that emphasizes investing in human capital, compensating people for performance, and committing to team development is critical for the success of innovative companies (McMahan et al., 1999; Muffatto, 1998). Therefore, innovation oriented organization is capable to manage its human resources with the innovation-oriented objectives.

4.3.3.2.1. Selection and Satisfaction Program

Innovation can come from many sources but a powerful resource lies in the minds and experiences of existing employees (Tidd et al., 2001). Companies need creative employees, who are flexible, risk taking, and tolerant of uncertainty and ambiguity (Madsen and Ulhøi, 2005). When firms use creative capabilities and innovative characteristics as hiring and selection criteria, their employees are likely to spawn diversity of ideas and commit to more innovation behaviors (Brockbank, 1999). An effective staffing system can help firms in selecting and allocating competent and qualified workforce to do the required tasks. Through effective staffing program, employees become important sources of new ideas in the company's innovation process.

Innovation initiatives tend to depend heavily on the employees' expertise, skills and motivation (Chen and Huang, 2007). Hiring qualified employees is critical activity for organization-wide innovation management but it does not provide sustainability without building company loyalty for employees. Companies need to consider employee satisfaction for holding their creative employees in the organization.

4.3.3.2.2. Competency Management

Innovation initiatives tend to depend heavily on employees' knowledge, expertise, and commitment as key inputs in the value creation process. According to Scarbrough (2003), human resource management function can influence and modify the attitudes, capacities, and behaviors of employees to achieve organizational goals and it plays a crucial role in nurturing the necessary conditions for catalyzing and channeling individuals towards the development of innovation activities.

Innovative organization develops organizational expertise in terms of demand and content for the innovation through training (Weisberg, 2006). Exposure to diverse training programs could foster employees to learn new knowledge and expertise, broaden their insight, and equip them with innovative minds and skills (Nonaka and Takeuchi, 1995). With regard to training, it would facilitate employees' exposure to variety of knowledge and openness to innovative ideas (Brockbank, 1999).

Similar to view of Brockbank (1999), innovation oriented organization provides its employees broad and various training programs to develop new knowledge, skills, and innovative capability necessary for performing their work. Investments in training can develop employee expertise at all levels of the organization, which is likely to provide a potentially inexhaustible source of ideas for further innovation (Torraco and Swanson, 1995).

4.3.3.2.3. Rewarding System

Performance appraisals and compensation are the primary strategic human resource practices that firms can use to reinforce employees' behaviors and induce them to comply with organizational goals (Scarbrough, 2003). In terms of performance appraisal, if companies want to elicit desired behaviors from employees, they must provide feedback and incentives that reinforce the desired behaviors (Collins and Clark, 2003).

Innovation requires a high level of involvement and participation of employees (Damanpour, 1991; Hurley and Hult, 1998). People play a partial role in the innovation process, if they feel that they will get some reward for their effort. Rewarding system is an essential part of organization-wide innovation management by encouraging employees to generate innovative ideas. Performance appraisal can enhance employees' motivation to engage in innovative activities, and make firms achieve favorable innovation results (Jiménez-Jiménez and Sanz-Valle, 2005). According to McCosh et al. (1998), with the aim of sustainability of innovative culture, it is important that innovative employees should be rewarded and announced to other employees.

A well-planned reward system is an effective tool to reinforce the expected behaviors and to shape the development of the desired climate (Balkin and Logan, 1988). The reward does not need to be money (Elgar, 2001). Both extrinsic and intrinsic rewards are essential to motivate employees to take the challenging work, and provide them incentives to generate new ideas and develop successful new products (Brockbank, 1999; Mumford, 2000).

4.3.3.3 Knowledge Management

Knowledge is a fundamental production factor as well as an innovative factor (Elgar, 2001). Knowledge management is an approach to adding or creating value by more actively leveraging the know-how and expertise resided in individual minds (Scarbrough, 2003); it is an organized and systematic approach encompassing the knowledge processes such as use, transform, transfer, store and retrieve knowledge in order to improve business performances.

The innovation process involves the acquisition, dissemination, and use of new and existing knowledge (Damanpour, 1991; Moorman and Miner, 1998). According to Subramaniam and Youndt (2005), an organization's innovativeness is closely tied to its ability to utilize its knowledge resources. Organizations that effectively manage and leverage the knowledge and expertise embedded in individual minds will be able to create more value and achieve superior competitive advantage (Scarbrough, 2003). Innovation oriented organization needs to focus on implementing the appropriated knowledge management initiatives in order to trigger the knowledge management outputs that influences the innovation processes.

Herkema (2003) defines innovation as a knowledge process aimed at creating new knowledge geared towards the development of commercial and viable solutions. In addition, Prasracos et al. (2002) indicate that management of organizational innovation can be enhanced by a good knowledge management system that is able to facilitate the capture of new information, and interpret this for the organization. Therefore, organizations willing to leverage their innovation capability need to manage their valuable knowledge assets with innovation-oriented objectives.

4.3.3.3.1. Knowledge Creation and Acquisition

Innovation can be defined as combination of a firm's existing knowledge assets to create new knowledge. Therefore, the primary task of the innovative organization is to reconfigure existing knowledge assets and resources, and to explore new knowledge (Nonaka et al., 1995; Galunic et al., 1998). Both exploration and exploitation of knowledge have been shown to contribute to the innovativeness of firms and to its competitive advantage (Swan et al., 1999; Hall et al., 2002). Combining new and existing knowledge, which is available within and outside the organization, is essentially important to offer a solution to the problem of innovation. This involves both generation of technological and market knowledge via research carried out within and outside the organization, and technology transfer between internal and external sources.

Knowledge acquisition from the outside marketplace and the inside employees provides opportunities for firms to recombine current knowledge and create new knowledge (Yli-Renko et al., 2001). The newly acquired knowledge interacting with the existing knowledge can modify organizational knowledge stock (Nonaka et al., 1995; Gold et al., 2001) and enhance the breadth and depth of knowledge available to the company, thereby increasing the potential for new innovative outcomes (Galunic et al., 1998; Yli-Renko et al., 2001). Cohen and Levinthal (1990) emphasize that innovation capability is the ability of companies to assimilate and utilize external information for transfer into new knowledge.

4.3.3.3.2. Knowledge Diffusion

Knowledge management plays a vital role in ensuring that knowledge required in the innovation process is available and accessible. Cavusgil et al. (2003) indicate that knowledge management can play a critical role in gathering tacit knowledge, internal

and external to the organization, through application of processes to ensure availability of knowledge for innovation teams.

It is precisely the sharing of knowledge across functional or organizational boundaries, through using cross-functional and inter-organizational teams that is seen as the key to the effective use of knowledge for innovation. Making right information available to the right people in the right manner can help to trigger new or innovative ideas. Thus, formalized knowledge diffusion significantly improves and supports innovation activities in an organization.

4.3.4 Environmental Relations

According to Porter (1985), sustainable competitive advantage involves dealing with competitive forces within a sector of industry to become distinct from competitors. In the industrial age, companies competed on the amount of internal knowledge they accumulated, and would gather as much information and know-how as possible internally to develop their innovations. Today it is no longer enough for companies to take advantage of the knowledge held within their own company. The new era of innovation is forcing companies to find new sources of innovation.

The world is becoming flat, which offers advantages to companies to easily monitor the changes in consumer's behavior, competitor's actions, technological improvements, economic conditions; involve customers into value creation process to create unique individual solutions; and collaborate with other companies through different networks by forming partnerships.

In the literature, the evolution of innovation is often described as depending on the organization's openness to the environment and its participation in external networks (Rothwell, 1994). Building and sustaining innovation-oriented relationships with the environment is becoming increasingly more important for business survival by means of innovativeness.

4.3.4.1 Environmental Analysis

Environmental scanning and analysis is a means to provide demand-driven, actionable information on the external environment; monitor the changes and trends in the environment. It should provide a comprehensive picture of the competitive

situation, including the company and industry's position in the life cycle (Burkhardt, 2001).

Innovation is triggered by detecting signals in the environment about potential for change. These signals can take the form of new technological opportunities, or changing requirements on the part of markets; they could be the result of legislative pressure or competitor action. According to Tushman and Scanlan (1981), the inputs from environmental scanning provide impetus for the initiation activity of the innovation process.

Purposeful, systematic innovation begins with the analysis of the sources of new opportunities (Drucker, 1985). These opportunities might be about technology, markets, competitive behavior, shifts in the political or regulatory environment, new social trends, etc. (Tidd et al., 2001). Therefore, there is a need for an effective searching and scanning process for picking the signals up in order to be organized and managed.

Companies operate in a particular context, and they are influenced by and are able to influence this environment. The business environment can be divided into two categories as described by Gillespie (2007): micro-environment and macro-environment.

4.3.4.1.1. Micro-Environmental Analysis

The micro-environment involves the individuals and organizations that have a direct interest in the activities of the firm and are clearly affected by its actions (Gillespie, 2007). As organizations are regularly interacting with others in the environment, the micro-environmental actors plays a critical role in the success of innovation.

The micro-environmental actors are consisted of customers, suppliers, competitors, distributers, etc. These actors are considered as valuable sources of innovation for companies (Laursen and Salter, 2006). Monitoring and analyzing the relevant information to customer needs, market trends and competitor actions is very critical to see the innovation opportunities. Company’s innovativeness can be increased by enriching the company’s own knowledge base through the integration of suppliers, competitors, and external knowledge sourcing (Lettl et al., 2006; Piller and Walcher, 2006).

Innovation oriented organization acquires new information from competitors and customers, and connected with existing knowledge to create new innovative solutions (Tushman and O'Reilly, 1997; Drucker, 1998).

4.3.4.1.2. Macro-Environmental Analysis

The macro-environment involves factors outside of the direct control of the business such as the economy, government policy and social change (Gillespie, 2007). Due to its tremendously complex and dynamic nature, the macro-environmental elements have a significant effect on a company's innovation strategies. Monitoring opportunities and threads towards the macro-environmental factors plays a critical role in the success of innovation.

The macro-environmental factors are defined as political, economic, social, technological and legal factors. These factors are considered as valuable sources of innovation for companies. Monitoring and analyzing the relevant information to political decisions, economic conditions, social trends, technological improvements and legal changes is very critical to see the innovation opportunities.

4.3.4.2 Co-Innovation

The rapid pace of technological change means that firms are increasingly being forced to look at some combination of internal generation and external acquisition (Tidd et al., 2001). In the era of open innovation, according to Chesbrough (2003), firms increasingly rely on external sources of innovation by emphasizing the ideas, resources and individuals flowing in and out of organizations, searching for and using a wider range of external ideas, knowledge and resources, networks. The innovation process, ideation, and collaboration in new product development are becoming more open.

Thrift (2006) summarizes the current trends in the innovation arena: "The new understanding of innovation currently shows up as three associated developments: as the mobilization of forethought, as the deepening of the lure of the commodity through the co-creation of commodities with consumers, and as the construction of different kinds of apparently more innovative space suffused with information technology".

Co-innovation means the collaboration between company's customers or users, or collaboration with other companies or universities and other knowledge-based

organizations to access external knowledge in order to innovate. With the help of collaboration, innovation is realized effectively while no company can accomplish by itself.

4.3.4.2.1. Customer Involvement

Market orientation has a significant positive influence on new product success and, consequently, and it is a crucial element of innovation management (Tomala and Senechal, 2004). As the individual consumer is being placed at the locus of innovation, providing unique and customized experiences to individuals is becoming more important. For this experience to be meaningful, companies have to include their consumers in the innovation process to provide them with solutions that satisfy their needs. Working with customers can often offer important insights and new directions (Tidd et al., 2001). In addition, early involvement and allowing the customers to play an active role in the innovation process leads to better adoption and higher quality innovation.

Integrating customers into the innovation process lowers the barriers to adopting innovations. Prahalad and Ramaswamy (2000) suggest that companies have to recognize that the customer is becoming a partner in creating value, and need to learn how to harness customer competences. According to McCosh et al. (1998), the company must keep close to its customers, partly to respond to their expressed needs, but mainly so that it can work out what they want in the future. Matthing et al. (2004) suggest that the value of customer involvement in new service development resides in the opportunity to facilitate proactive learning about the customer, and to understand and anticipate latent customer needs.

Building up an understanding of the changing marketplace requires various forms of communication and interaction, from monitoring through to customer panels and surveys. There are different ways for involving users in the innovation processes. Companies tap tacit knowledge from their users by employing some methods during the innovation process. The collected data is analyzed in order to understand the patterns of user behavior. Users can also be involved the innovation process by being an active part of the innovation team and participating in developing innovations for the company. This type of users, which are named as advance users, have first-hand knowledge when it comes to using a product or service and have their own ideas about how to develop or create innovations (Tidd et al., 2001).

4.3.4.2.2. Collaboration Networks

The increasingly complex nature of innovation requires companies to tap knowledge, intangible resources and talent from out of the organization, collaborating across borders; no single company has all the resources of knowledge required to innovate on their own. Koschatzky (2001) expresses that firms which do not cooperate and which do not exchange knowledge reduce their knowledge base on a long-term basis and lose the ability to enter into exchange relations with other firms and organizations.

Biemans (1990) suggests that cooperation, coordination, and communication reduce the level of chaos in an innovation process, and, thus, increases the probability of developing successful innovation. Therefore, companies need to form collaborative networks and partnerships for innovation. That is essential to create total solutions to customers' needs. Network cooperation or using a wide range of external actors and sources had a positive impact on innovation performance of firms (Brioschi et al., 2002). Becker and Dietz (2004) explicitly indicate that cooperation with different partners on research and development had a positive effect on innovation achievement. In summary, building innovation-focused collaboration networks is essential to increase innovativeness and reduce time to market.

Collaboration networks consist of different actors with the aim of accessing the knowledge: suppliers, competitors, universities and other knowledge-based organizations (OECD, 2009). Partnership can take on many forms with these network actors. Some partnerships are based on research projects where companies' R&D departments work together in order to develop new solutions. Other partnerships are formed to create new products or services, by combining existing methods and technologies with other products and services in a new way. While yet other partnerships are formed within the value chain in order to optimize production processes, distributions, sales and so on.

According to OECD (2009), as companies form partnerships to innovate in the new era, companies' structure and organization will have to change to allow for the methods of collaboration, and employees will have to learn how to work in teams, while management will have to change their decision-making culture.

4.4 Measuring Innovative Performance

The old saying “You can not manage what you can not measure” emphasizes the importance of performance measurement to enable effective management. Performance measurement is the selection and use of quantitative measures of capacities, processes, and outcomes to develop information about critical aspects of activities, including their effect on the public (Perrin et al., 1999). In this respect, innovation performance measurement has significant importance for innovation oriented organization in order to measure, evaluate and manage organization-wide innovation activities successfully.

In the literature, there are numerous studies exploring the innovation performance measures. It is widely acknowledged that it is difficult to determine suitable indicators to measure the innovation performance of companies (Romijn and Albaladejo, 2002). Researchers have consistently pointed at the nonlinear, often random nature of the process of innovation, which involves many facets of the organization, its members and its environment (Danneels and Kleinschmidt, 2001; Sethi and Nicholsan, 2001). The enormous breadth and depth of subsystems and variables involved in managing innovation is laid out in a research review article by Johne and Snelson (1988). The complexities are further emphasized in technology-based environments, where endogenous and exogenous forces of innovation cannot be isolated easily. All of these factors compound the nonlinear nature of innovation process, making it even less likely to find simple models for researching these environments. Moreover, as the sources of innovation become more diverse and distributed throughout industries and geographic regions, companies shift the focus beyond their own organizational boundaries, often engaging in collaboration to create joint intellectual property. The processes involved in generating innovative ideas, ultimately transferring them into the market, are highly sophisticated and complex. In summary, all of these create great challenges for both practitioners and management researchers working on innovation performance measurement (Thamhain, 2005).

From the management point of view, the key output measure is the success of the company. Company success can be associated to profits, revenue growth, share performance, market capitalization or productivity, etc. However, these traditional performance measures, based on financial information, are not sufficient to represent

the overall performance of company in terms of innovation management. As stated by Mavrinac and Siesfeld (1997), in a very dynamic and world market economy, marked by fast technological developments, the future financial performances are evaluated better by non-financial indicators than by financial indicators.

Innovation oriented organization should consider a combination of financial and non-financial performance indicators when measuring organization-wide innovation activities. In this perspective, financial and non-financial performance indicators were determined by gathering the outputs of literature review in order to measure the innovation performance of the companies. In this way, the relationship between the proposed framework components and innovation performance indicators could be discussed in order to confirm the impact of the tentative framework components on innovation performance indicators, in practice.

Multiple innovation performance indicators are adopted to develop a set of measures to better demonstrate the actual performance of organization-wide innovation management in a company. Financial performance indicators are shown in Table 4.6, and non-financial performance indicators are shown in Table 4.7.

Table 4.6: Innovation-based financial performance indicators

Indicators	Explanation
Return on Investment:	the ratio of resources gained or lost in innovation process to the total amount of resources provided (Thamhain, 2005)
Revenue Growth:	the percent increase or decrease in a company's revenue from innovation between two or more equivalent fiscal periods (Souitaris, 2001; Krause, 2004)
Cost Savings:	the amount of costs saved by innovation without reducing quality below the level required to meet end user needs (Thamhain, 2005; OECD Oslo Manual, 2005)

Table 4.7: Innovation-based non-financial performance indicators

Indicators	Explanation
Number of Innovation:	the number of innovative solutions offered to customers (Nystom et al., 2002; Thamhain, 2005)
Customer Satisfaction:	the value of innovative solution perceived by customer (Tidd et al., 2001; Thamhain, 2005)
Idea Channel Effectiveness:	the efficiency of collecting ideas from different sources (Tidd et al., 2001; Thamhain, 2005)
Time to Market:	the length of time it takes from an innovative idea being captured until its being available to user (Tidd et al., 2001; Thamhain, 2005; Parjogo et al., 2007)

All of the innovation performance indicators were found out through an extensive literature review. In addition to the academic sources, the annual innovation surveys from consultancy companies have been investigated as well. In terms of industry's overall attitude to innovation measurements, it is the Boston Consulting Group's (BCG) senior management survey entitled "Measuring Innovation 2009". According to the BCG report, companies of the survey respondents focus on some important performance indicators in order to measure their innovation competencies (Figure 4.1). The performance measurement indicators presented by the BCG report confirm the validity of the innovation performance indicators, which are collected through an extensive literature review for this study. In summary, the performance indicators, which are employed to validate the proposed framework components, are recognized both academically and professionally.

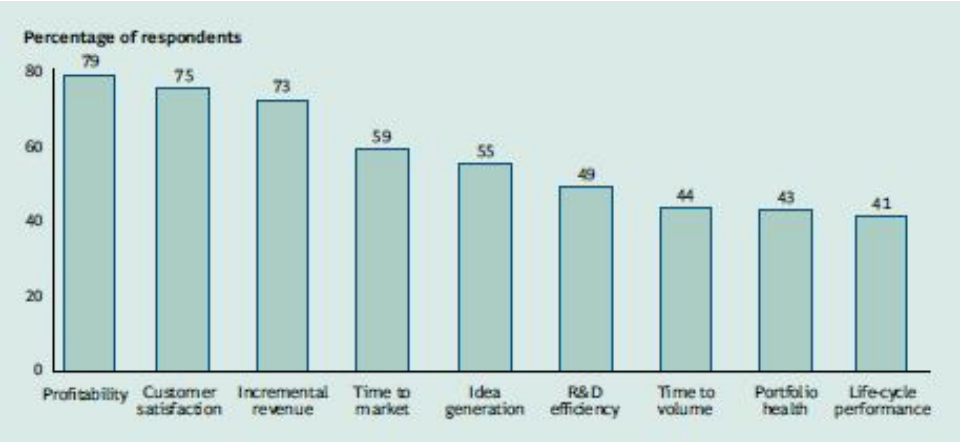


Figure 4.1: Usage rate of innovation metrics (BCG 2009 Senior Executive Innovation Metrics Survey)

5. EMPIRICAL ANALYSIS METHODOLOGY

5.1 Survey Design

Survey study was conducted to examine the validity of the framework of innovation oriented organization (IOO). For this purpose, a questionnaire was designed in order to collect data to investigate the importance of framework components and the relationship between company accomplishment in framework components and innovation performance indicators, from a practical point of view. All questions in the survey were derived from the individual framework components and innovation performance indicators.

The questionnaire design was divided into four main sections. The first section aimed to question the knowledge of participants about innovation management and measurement activities performed in their companies. The second section focused on the components of framework to obtain two main ratings: the importance level of framework components based on personal knowledge and experience, and the company accomplishment level in framework components. The third section focused on the innovation performance indicators for the participant company by requesting subjective judgments of the performance satisfaction level. Through the fourth section, questionnaire was finalized by acquiring participant's information and expressing the appreciation. For the questions in the second and third sections, five-point Likert scale with interval data was adopted.

The questionnaire was verified by five experienced advisers from both industry and academic field in order to establish the content validity. Improvement and modification of the questionnaire was done by revision and evaluation with the advisers. In this way, survey items were purified and any potential deficiency was rectified. Minor adjustments were made on the basis of specific suggestions.

The Appendix A.1 shows the content of the questionnaire in English while the Appendix A.2 presents the content of the questionnaire in Turkish. In addition, survey invitation mail is presented in the Appendix A.3 and Appendix A.4.

5.2 Data Collection

The sample for this study was derived from the 'Turkish Telecom Industry Catalog' that includes the complete list of companies from information and communication technologies (ICT) industry in Turkey. ICT industry was chosen due to its knowledge-based and innovation-oriented characteristics.

The targeted population was consisted of innovation managers, R&D managers, marketing managers, sales managers or business development managers, with the intention of contacting the various key informants on different type of innovation activities.

The questionnaire was sent to 350 firms randomly chosen from the industry catalog, and 127 respondents returned the completed questionnaire, yielding a response rate of 29%. After removing some responses due to data inconsistency and incompetence, the final valid sample for statistical testing was 93.

The questionnaire was prepared on a web platform providing online survey service and invitation requests were sent to participants via e-mail. In the invitation e-mail, the objective of the research and survey study was explained, the confidentiality of the collected information was especially emphasized and the authors' appreciation was also expressed. To increase the return rate, the participants were informed that they would receive a summary report of the study if they returned the completed questionnaire. Questionnaire was active for two weeks, and during this period two reminders were sent to invoke the participants. The response rate can be considered acceptable in the light of the director-level target group.

5.3 Statistical Methods

There were three stages of statistical analysis in this research. The first stage was included descriptive statistics of the framework components, which indicated the importance level of each component. This stage aimed to determine which of the framework components are perceived as important factors for organization-wide innovation management from the perspective of business professionals.

In the second stage, factor analysis was applied to reduce the number of framework components and innovation performance indicators. Hair et al. (1987) describe the

application of factor analysis as a means by which to analyze the interrelationships among a large number of variables and explaining these research variables in terms of their common underlying dimensions such as factors or constructs.

Third stage consisted of multiple regression analysis in order to investigate the relationships between core components of the innovation oriented organization framework and innovation performance indicators. The general purpose of multiple regression is to learn more about the relationship between several independent variables and a dependent variable. In this research, multiple regression analysis was employed to understand how the typical value of the dependent variable changes when any one of the independent variables is varied, while the other independent variables are held fixed. With the aim of examining the impacts of framework components on company accomplishment in terms of organization-wide innovation management, framework components were assigned as independent variables and innovation performance indicators were assigned as dependent variables.

6. RESULTS

With the aim of validation of the proposed framework, the statistical results of the survey were analyzed by examining the importance level of framework components and the impact level of framework components on innovation performance.

The responses related to the importance level of the framework components were analyzed in order to determine which of the components were considered important in terms of innovation management by business people. The acceptance level was decided to be greater than the mid-point value of the scale, which is greater than three on five-point Likert scale with interval data. From the survey results, the ranking scores of importance level of framework components illustrated that all of the components are significantly important from the perspective of innovation management. As shown in Table 6.1, the means for importance level of framework components are ranged from 4.13 to 4.71 with a fairly stable standard deviation ranging from 0.50 to 0.85.

As the next step in validation of the proposed framework, the relationship between the components of innovation oriented organization and the indicators of innovation performance was examined in order to substantiate the impact of the core components of the framework on the performance of innovation management. Factor analysis is able to reduce the number of variables, if the statistical requirements of the variables are fulfilled. Reduction of variables was carried out for both company accomplishment in framework components and innovation performance indicators, separately.

In order to reduce the number of independent variables, which consist of the framework components, factor analysis was performed. The independent variables with all 19 items were analyzed as a confirmatory factor analysis. Table 6.2 shows the result of factor analysis for independent variables. All factor loadings are greater than 0.50, leading to a conclusion that the reliabilities of individual framework components are within acceptable levels (Nunnally, 1978). According to Hair et al. (1987), factor loadings greater than 0.30 are considered significant, while loadings

over 0.50 are considered very significant. All factor loadings were well above the 0.50 level, and as such, can be considered as demonstrating a high level of significance. Composite reliability coefficients for the constructs are all greater than 0.70, suggesting that a high internal reliability existed in the constructs (Fornell and Larcker, 1981). The percentage of total variance explained in each group is greater than 60, which suggests that the items are able to explain the variance in the constructs. In addition, the KMO test result lies between 0.500 and 0.875, which conforms to the suggested minimum standard of 0.50 required to proceed with factor analysis (Joseph and Hair, 2006). These numbers validate the consistency and reliability of the result; four constructs were produced against 19 variables.

Table 6.1: Mean and standard deviation for importance of framework components

Importance of Framework Components	Mean	Std. Dev.
Idea Generation and Evaluation	4.53	0.60
Project Definition and Feasibility	4.44	0.63
Solution Implementation	4.49	0.63
Solution Launch	4.60	0.61
Feedback Analysis	4.32	0.75
Continuous Learning	4.21	0.80
Vision and Strategy	4.40	0.81
Organization Structure	4.23	0.81
Key Individuals	4.17	0.85
Innovation Culture	4.69	0.53
Top Management Influence	4.71	0.50
Innovation Climate	4.18	0.75
Selection and Satisfaction	4.19	0.81
Competency Management	4.23	0.69
Rewarding System	4.43	0.68
Knowledge Management	4.13	0.71
Information Technologies	4.14	0.68
Environmental Analysis	4.62	0.59
Co-Innovation	4.35	0.76

Table 6.2: Results of factor analysis for company accomplishment in framework components

Constructs	Factor Loading	Eigenvalue/Variance explained (percent)	Cronbach α
Innovation Process		4.094/68.23	0.906
Idea Generation and Evaluation	0.695		
Project Definition and Feasibility	0.688		
Solution Implementation	0.858		
Solution Launch	0.656		
Feedback Analysis	0.862		
Continuous Learning	0.643		
Organizational Infrastructure		4.344/72.39	0.923
Vision and Strategy	0.792		
Organization Structure	0.834		
Key Individuals	0.756		
Innovation Culture	0.836		
Top Management Influence	0.770		
Innovation Climate	0.665		
Supportive Systems		3.396/67.92	0.878
Selection and Satisfaction	0.783		
Competency Management	0.616		
Rewarding System	0.756		
Knowledge Management	0.809		
Information Technologies	0.739		
Environmental Relations		1.599/79.95	0.744
Environmental Analysis	0.732		
Co-Innovation	0.663		

Notes: KMO test – 0.500 – 0.875; Bartlett's test – Sig.: 0.000

In order to reduce the number of dependent variables, which consists of the innovation performance indicators, factor analysis was performed. The dependent variables with all seven items were analyzed as a confirmatory factor analysis. Table 6.3 shows the result of factor analysis for dependent variables. All factor loadings are greater than 0.50, leading to a conclusion that the reliabilities of innovation performance indicators are within acceptable levels (Nunnally, 1978). According to Hair et al. (1987), factor loadings greater than 0.30 are considered significant, while

loadings over 0.50 are considered very significant. All factor loadings were well above the 0.50 level, and as such, can be considered as demonstrating a high level of significance. Composite reliability coefficients for the constructs are all greater than 0.70, suggesting that a high internal reliability existed in the constructs (Fornell and Larcker, 1981). The percentage of total variance explained in each group is greater than 60, which suggests that the items are able to explain the variance in the constructs. In addition, the KMO test result lies between 0.500 and 0.870 that conforms to the suggested minimum standard of 0.50 required to proceed with factor analysis (Joseph and Hair, 2006). These numbers validate the consistency and reliability of the result; two constructs were produced against seven variables.

Table 6.3: Results of factor analysis for innovation performance indicators

Constructs	Factor Loading	Eigenvalue/Variance explained (percent)	Cronbach α
Financial Measurement		2.328/77.61	0.855
Innovation ROI	0.787		
Revenue Growth	0.685		
Cost Savings	0.878		
Non-Financial Measurement		2.975/74.36	0.885
Number of Innovation	0.703		
Customer Satisfaction	0.760		
Idea Channel Effectiveness	0.782		
Time to Market	0.848		

Notes: KMO test – 0.500 – 0.870; Bartlett's test – Sig.: 0.000

Due to the collection of all measures from the same source, the Harman one-factor test was employed to examine the potential problem of common method variance. Significant common method variance would result if one general factor accounts for the majority of covariance in the variables (Podsakoff and Organ, 1986). All items from the main constructs were included into an exploratory factor analysis to determine whether the majority of the variance could be accounted for by one general factor. This operation was performed for independent variables and dependent variables separately. Since a single factor does not emerge and one general factor does not account for most of the variance, common method bias is unlikely to be a serious problem in the data (Podsakoff and Organ, 1986).

After grouping the variables based on the largest factor loading values, constructs were interpreted by considering the similarities. In result, four constructs -innovation process, organizational infrastructure, supportive systems, and environmental relations- were obtained for framework components and two constructs -financial performance and nonfinancial performance- were obtained for innovation performance indicators.

Regression analysis was carried out to investigate the relationship between these constructs; core components of IOO framework were assigned as independent variables and indicators of innovation performance were assigned as dependent variables. The aim is to find the estimates of the effect of independent variables on dependent variables. Independent variables are consisted of these constructs: innovation process, organizational infrastructure, supportive systems and environmental relations. Dependent variables are consisted of these constructs: financial performance indicators and non-financial performance indicators.

Since there are two dependent variables, two multiple regression models were produced. First model asked whether framework components affect innovation-based financial performance. And, second model queried that innovation-based non-financial performance is determined by framework components.

The model summary shown in Table 6.4 refers to the regression of framework components on financial performance indicators. In the column labeled R is the value of the multiple correlation coefficient between framework components and financial performance. The simple correlation between them is significantly high (R=0.903). The next column gives the value of R^2, which is a measure of how much of the variability in the outcome is accounted for by the independent variables. For this model, its value is 0.816, which means that framework components accounts for 81.6% of the variation in financial performance. The adjusted R^2 shows how well the model generalizes. Its value is very close to the value of R^2 (0.816-0.808=0.008 or 0.8%) which indicates that if the model derived from the population rather than a sample it would account for approximately 0.8% less variance in the outcome.

Table 6.4: Model summary for regression of framework components on financial performance indicators

				Change Statistics				
R	R^2	Adjusted R^2	Std. Error of the Estimate	R^2 Change	F Change	df1	df2	Sig. F Change
0.903	0.816	0.808	0.25170	0.816	97.666	4	88	0.000

Table 6.5 contains the results of an analysis of variance (ANOVA) that tests whether the model is significantly better at predicting the outcome than using the mean as a 'best guess'. Specifically, the F-ratio represents the ratio of the improvement in prediction that results from fitting the model labeled 'Regression' in the table, relative to inaccuracy that still exists in the model labeled 'Residual' in the table. If the improvement of due to fitting the regression model is much greater than the inaccuracy within the model then the value of F will be greater than one. For the model shown in Table 6.5, the F-ratio is 97.66, which is very unlikely to have happened by chance ($p<0.000$). This result can be interpreted as meaning that the model significantly improves the ability to predict the dependent variable.

Table 6.5: ANOVA table for regression of framework components on financial performance indicators

	Sum of Squares	df	Mean Square	F	S
Regression	24.749	4	6.187	97.666	0.000
Residual	5.575	88	0.63		
Total	30.324	92			

In multiple regression the model takes the form of an equation that contains a coefficient (B) for each independent variable. The first part of the table introduces estimates for these B values, and these values indicate the individual contribution of each independent variable to the model. Since all these B values are positive, a positive relationship exists between each framework component and innovation-based financial performance. So, if one of the framework components is improved, then financial performance of the company increases as well. The B values also indicate what degree of each independent variable affects the dependent variable if the effects of all other independent variables are held constant. If the t-test associated with a B value is significant and the value in the column labeled in Sig. is less than 0.05 then the independent variable is making a significant contribution to the model. In the model shown in Table 6.6, each framework component is significant

contributor of financial performance. From the magnitude of the t-statistics it can be seen that any framework component has not slightly more impact than the others. The standardized Beta value (β) is a measure of how strongly each independent variable influences the dependent variable and it is measured in units of standard deviation. Thus, the higher the beta value the greater the impact of the independent variables on the dependent variable. The standardized beta coefficients give a measure of the contribution of each variable to the model. A large value indicates that a unit change in that independent variable has a large effect on the dependent variable. The standardized beta values indicate that all components have significant impact on innovation-based financial performance and any framework component has not slightly more impact than the others do.

Table 6.6: Coefficients table for regression of framework components on financial performance indicators

	Unstandardized Coefficients		Standardized Coefficients			Correlations		
	B	Std. Error	Beta	t	Sig.	Zero-order	Partial	Part
(Constant)	.282	.166		1.700	.093			
Innovation Process	.249	.058	.283	4.302	.000	.770	.417	.197
Organizational Infrastructure	.220	.051	.272	4.353	.000	.747	.421	.199
Supportive Systems	.244	.055	.278	4.429	.000	.751	.427	.202
Environmental Relations	.213	.054	.251	3.971	.000	.741	.390	.181

The model summary shown in Table 6.7 refers to the regression of framework components on non-financial performance indicators. In the column labeled R is the value of the multiple correlation coefficient between framework components and innovation-based non-financial performance. The simple correlation between them is significantly high (R=0.944). The next column gives the value of R^2, which indicates how well the variation in the dependent variable is explained by regression model. For this model, its value is 0.891, which means that framework components are able to explain 89.1% of the variation in non-financial performance. The adjusted R^2

shows how well the model generalizes. Its value is very close to the value of R^2 (0.891-0.886=0.005 or 0.5%) which indicates that if the model derived from the population rather than a sample it would account for approximately 0.5% less variance in the outcome.

Table 6.7: Model summary for regression of framework components on non-financial performance indicators

			Std. Error	Change Statistics				
		Adjusted	of the	R^2	F			Sig. F
R	R^2	R^2	Estimate	Change	Change	df1	df2	Change
0.944	0.891	0.886	0.19686	0.891	179.466	4	88	0.000

Table 6.8 contains the results of an analysis of variance (ANOVA) that tests whether the model is significantly better at predicting the outcome than using the mean as a 'best guess'. Specifically, the F-ratio represents the ratio of the improvement in prediction that results from fitting the model labeled 'Regression' in the table, relative to inaccuracy that still exists in the model labeled 'Residual' in the table. If the improvement of due to fitting the regression model is much greater than the inaccuracy within the model then the value of F will be greater than one. For the model shown in Table 6.8, the F-ratio is 179.46, which is very unlikely to have happened by chance ($p<0.000$). This result can be interpreted as meaning that the model significantly improves the ability to predict the dependent variable.

Table 6.8: ANOVA table for regression of framework components on non-financial performance indicators

	Sum of Squares	df	Mean Square	F	S
Regression	27.821	4	6.955	179.466	0.000
Residual	3.410	88	0.39		
Total	31.231	92			

In multiple regression the model takes the form of an equation that contains a coefficient (B) for each independent variable. The first part of the table introduces estimates for these B values, and these values indicate the individual contribution of each independent variable to the model. Since all these B values are positive, a positive relationship exists between each framework component and non-financial performance. So, if one of the framework components is improved, then non-financial performance of the company increases as well. The B values also indicate what degree of each independent variable affects the dependent variable if the effects

of all other independent variables are held constant. If the t-test associated with a B value is significant and the value in the column labeled in Sig. is less than 0.05 then the independent variable is making a significant contribution to the model. In the model shown in Table 6.9, each framework component is significant contributor of non-financial performance. From the magnitude of the t-statistics it can be seen that any framework component has not slightly more impact than the others. The standardized Beta values (β) are all measured in standard deviation units and so are directly comparable; therefore, they provide a better insight into the importance of an independent variable in the model. The standardized beta coefficients give a measure of the contribution of each variable to the model. A large value indicates that a unit change in that independent variable has a large effect on the dependent variable. The standardized beta values indicate that all components have significant impact on innovation-based non-financial performance and any framework component has not slightly more impact than the others do.

Table 6.9: Coefficients table for regression of framework components on non-financial performance indicators

	Unstandardized Coefficients		Standardized Coefficients			Correlations		
	B	Std. Error	Beta	t	Sig.	Zero-order	Partial	Part
(Constant)	.077	.130		0.590	.557			
Innovation Process	.283	.045	.316	6.237	.000	.811	.554	.220
Organizational Infrastructure	.261	.040	.318	6.586	.000	.794	.575	.232
Supportive Systems	.235	.043	.263	5.441	.000	.773	.502	.192
Environmental Relations	.201	.042	.234	4.810	.000	.761	.456	.169

To investigate the framework in detail, core components and their impacts on innovation performance were explained and discussed in the next section.

7. DISCUSSION

The framework of innovation oriented organization (IOO) was designed to include a systematic innovation process which is guided and supported at the top by the firm's strategies, its people and culture, organizational structure and processes, as well as information and knowledge. The framework was conceptualized in terms of general system approach by considering organization as an open system and designed through axiomatic design methodology in detail. This approach distinguishes the developed framework by means of the scientific and systematic characteristics.

With the aim of validation of the proposed framework, an empirical survey was conducted to collect data from companies in information and communication technologies industry in Turkey. Then, multiple regression analysis was employed on the collected data to investigate the relationship between the IOO framework components and innovation-based performance. At this point, core components of IOO framework were assigned as independent variables and indicators of innovation performance were assigned as dependent variables. The results of regression analysis are presented in the previous section in detail. As a statistical summary, the results of regression analysis between the four independent variables and the two dependent variables are shown in Table 7.1.

Table 7.1: Result of regression analysis between core components and innovation performance indicators

Independent Variables	Dependent Variables			
	Financial Performance (R^2=0.808, F=97.666*)		Non-Financial Performance (R^2=0.886, F=179.466*)	
	β	t	β	t
Innovation Process	.283	4.302	.316	6.237
Organizational Infrastructure	.272	4.353	.318	6.586
Supportive Systems	.278	4.429	.263	5.441
Environmental Relations	.251	3.971	.234	4.810

Notes: *$p < 0.01$

The four core components of IOO framework are explained 80.8 percent of the variance in innovation financial performance (R^2=0.808, F=97.666, Sig.=0.000). The beta (β) values confirm that all core components of IOO framework strongly influence the innovation-based financial performance. Each framework component is significant contributor of financial performance. So, if one of the framework components is improved, then financial performance of the company increases as well.

On the other hand, the four core components of IOO framework are explained 88.6 percent of the variance in innovation non-financial performance (R^2=0.886, F=179.466, Sig.=0.000). Thus, it is confirmed that there is a positive relationship between core components of IOO framework and innovation-based non-financial performance. Each framework component is significant contributor of non-financial performance. It means that non-financial performance of the company increases when one of the framework components is improved.

In summary, the values in Table 7.1 indicate the validity of the proposed framework. In parallel to the objective of this study, the regression shows that core components of IOO framework are highly significant predictors of innovation performance, both financial and non-financial dimension.

With the aim of investigation of the framework in detail, framework core components and their impacts on innovation performance are explained and discussed in the next parts below.

7.1 Innovation Oriented Organization

After the investigation of the relationship between IOO framework and innovation-based performance, it has been found out that framework components strongly influence both the financial performance and non-financial performance, in terms of innovation management (Table 7.1). In addition to these findings, the individual contribution of each framework component to the innovation-based performance is so close to each other. It means that all components have significant impact on innovation-based performance and any framework component has not slightly more impact than the others do. This situation can be associated with the interrelationship property of a system. According to GST, system is a collection of its subsystems,

which are worked together for the purpose of the system. Similar to this fact, innovation oriented organization consists of some independent subsets working together for the overall goal. Moreover, innovation oriented organization is more than the sum of its components.

An organization can be named as an innovation oriented organization if it has a well-defined innovation process, operates in an innovation-friendly organizational infrastructure, performs supportive operations to facilitate innovation activities, and develops innovation-oriented relations with environmental actors.

Innovation process component is the fundamental unit of the main system in order to transform inputs such as ideas, knowledge, and materials to innovative solutions. Organizational infrastructure component consists of structural subsystem, social and cultural subsystem, goal and values subsystem. Supportive systems component includes knowledge management system, human resource management system and information technologies. All these subsystems interact with each other to facilitate the goal of the main system. With the aim of interrelation with external environment as an open system, the framework of innovation oriented organization includes a component named as environmental relations.

If companies wish to become and remain innovative, they should pay special attention to the variables that these predictors consist of. The regression results and interpretations of the core components of the framework are described as follows.

7.2 Innovation Process

Innovation process was validated to be the one of the critical core components by being founded as one of the strongest predictor of company innovation performance as illustrated in Table 7.1. Innovation process were diagnosed as having a significant positive impact on both financial performance (β=0.283, t=4.302) and non-financial performance (β=0.316, t=6.237). The results of statistical analysis confirm the role of innovation process in innovation oriented organization. Innovation process has positive and significant effects on both financial and non-financial innovation performance.

As emphasized by Thamhain (2005), the process involved in generating innovative ideas, and ultimately transferring them into the market, is highly sophisticated and

complex. Organizing innovation development activities in a systematic manner is the foundation to build an organization-wide innovation management system. A well-designed innovation process helps business to identify, evaluate, develop, implement and exploit innovative solutions more efficiently and effectively. Innovation oriented organization focuses on a systematic innovation process, and performs strategic and operational activities in order to handle opportunities for innovative solutions.

Innovation process component consists of six sub-components: idea generation and evaluation, project definition and feasibility, solution implementation, solution launch, feedback analysis, continuous learning. According to the result of factor analysis as shown in Table 6.2, these six sub-components are capable of explaining the construct of innovation process with high reliability.

Innovation oriented organization builds idea channels, and manages them effectively in order to collect the new ideas from various sources. After collecting relevant trigger ideas from internal and external sources and making strategic decisions to pursue some of them, the next key phase of innovation process is actually turning those potential ideas into a new product or service, a change in process, a shift in business model (Bessant and Tidd, 2007). After conceptualization is completed, design, implementation, and testing of the innovative solution are performed through the solution implementation stage (Preez and Louw, 2008). As confirmed by Adams et al. (2006), successful introduction of new products and services into markets is important for the survival and growth. Innovation oriented organization knows that innovation process is not completed after the innovative solution is exploited to users or customers successfully. As the last steps of innovation process, customer feedback management and continuous learning are important subjects to enhance the innovation process (Hurley and Hult, 1998).

7.3 Organizational Infrastructure

Organizational infrastructure was validated to be the one of the critical core components by being founded as one of the strongest predictor of company innovation performance as illustrated in Table 7.1. Organizational infrastructure were diagnosed as having a significant positive impact on both financial performance (β=0.272, t=4.353) and non-financial performance (β=0.318, t=6.586). The results of statistical analysis confirm the role of organizational infrastructure in innovation

oriented organization. Innovation performance has a significant positive relation with organizational infrastructure.

The most important element in innovation is not having the idea or making the invention, but to struggle to get the idea or invention realized. There are many ideas and many creative people, but there is also great resistance to new ideas in organizations (Elgar, 2001). As stated by Preez and Louw (2008), a framework of organization-wide innovation management should include a well-defined combination of structure and flexibility in order to effectively deploy all elements of successful innovation. In other words, there is an essential need to design organizational infrastructure in the way to enable innovation throughout the organization.

Innovation depends on having a supportive organizational context in which creative ideas can emerge and be effectively deployed (Tidd et al., 2001). Building and maintaining such organizational conditions are a critical part of innovation management, and involve working with structures, work organization arrangements and communication arrangements.

Organizational infrastructure of innovation oriented organization consists of formal and informal dimensions. Formal dimension includes three sub-components: vision and strategy, organization structure, key individuals. Informal dimension includes three sub-components: innovation culture, top management influence, innovation climate. According to the result of factor analysis as shown in Table 6.2, these six sub-components are capable of explaining the construct of organizational infrastructure with high reliability.

From the perspective of formal dimension of organizational infrastructure, innovation oriented organization should outline a vision for innovation that describes the importance of innovation to the organization in achieving its business vision, and this relationship should be clearly articulated. In addition, creating organizational structure and processes in the way to enable the change is strongly linked to success in innovation management. Moreover, the presence of key enabling figures is an important element of innovation oriented organization.

From the perspective of informal dimension of organizational infrastructure, successful innovation management requires that the innovation culture be created to

take risks and to accept failure as an opportunity for learning and development (Tidd et al., 2001). In addition, top management influence is a strong predictor for the realization of innovative ideas and management of organizational innovation (Lee and Chang, 2006) as innovation begins with top management who believe organizational innovation is the way to survival. Moreover, innovation oriented organization creates an innovation climate in which innovation and creativity can be encouraged or hampered (Tidd et al. 1997).

7.4 Supportive Systems

Supportive systems were validated to be the one of the critical core components by being founded as one of the strongest predictor of company innovation performance as illustrated in Table 7.1. Supportive systems were diagnosed as having a significant positive impact on both financial performance (β=0.278, t=4.429) and non-financial performance (β=0.263, t=5.441). The results of statistical analysis confirm the role of supportive systems in innovation oriented organization. Supportive systems have positive and significant effects on both financial and non-financial innovation performance.

Innovation oriented organization needs supportive systems to move innovations from idea or opportunity through the reality (Tidd et al., 2001). As stated by Starbuck (1992), innovations arise at the intersection between flows of people and flows of knowledge. From this point of view, enhancing knowledge assets, managing human resources and establishing information flow are very critical to become an innovative organization. These supportive activities help to increase the efficiency of innovation process in terms of organization-wide innovation management.

Supportive systems involved in innovation oriented organization consist of human resource management system, knowledge management system and information technologies. In addition, human resource management system includes three sub-components: employee selection and satisfaction, competency management, rewarding system. According to the result of factor analysis as shown in Table 6.2, these five sub-components are capable of explaining the construct of supportive systems with high reliability.

For innovation oriented organization, human resource management function influences and modifies the attitudes, capacities and behaviors of employees in the way to achieve organizational goals. According to Scarbrough (2003), it plays a crucial role in nurturing the necessary conditions for catalyzing and channeling individuals towards the development of innovation activities. As stated by Brockbank (1999), innovation oriented organization provides its employees broad and various training programs to develop new knowledge, skills, and innovative capability necessary for performing their work. Rewarding system is also an essential part of organization-wide innovation management by encouraging employees to generate innovative ideas since innovation requires employees a high level of involvement and participation (Damanpour, 1991; Hurley and Hult, 1998).

Innovative organization willing to leverage its innovation capability needs to focus on implementing the appropriated knowledge management initiatives in order to trigger the knowledge management outputs that influence the innovation processes. Both exploration and exploitation of knowledge have been confirmed to contribute to the innovativeness of firms and to its competitive advantage (Levinthal et al., 1993; Hall et al., 2002). It is precisely the sharing of knowledge across functional or organizational boundaries, through using cross-functional and inter-organizational teams, is considered as the key to the effective use of knowledge for innovation.

In innovation oriented organization, knowledge and information flows are the key determinants of successful innovation (Tidd et al., 1997). Therefore, information and communication technology is a general technology which is increasingly been used as a technology for developing innovations (Elgar, 2001).

7.5 Environmental Relations

Environmental relations were validated to be the one of the critical core components by being founded as one of the strongest predictor of company innovation performance as illustrated in Table 7.1. Environmental relations were diagnosed as having a significant positive impact on both financial performance (β=0.251, t=3.971) and non-financial performance (β=0.234, t=4.810). The results of statistical analysis confirm the role of environmental relations in innovation oriented organization. Innovation performance has a significant positive relation with environmental relations.

The concept of open innovation is increasingly becoming recognized as relevant to an era in which networking and inter-organizational behavior is the dominant mode of operation (Tidd et al., 2001). Within the area of environmental relations, developing close and rich interaction with markets, with suppliers of technology and other organizational players, is of critical importance. Environmental relations offer opportunities for learning from though customers and lead users, from competitors, from strategic alliances and from alternative perspectives.

Innovative organizations pick up signals about innovation possibilities through exploring a particular selection environment (Tidd et al., 2001). Building and sustaining innovation-oriented relationships with the environment is becoming increasingly more important for business survival in terms of innovativeness. Environmental relations stand for monitoring the changes and trends in the environment and integrating the environmental actors into the innovation activities. In the literature, the evolution of innovation is often described as depending on the organization's openness to the environment and its participation in external networks (Burns and Stalker, 1961; Peters and Waterman, 1982).

Environmental relations include two sub-components: environmental scanning and co-innovation. According to the result of factor analysis as shown in Table 6.2, these two sub-components are capable of explaining the construct of environmental relations with high reliability.

Environmental scanning is critically important since purposeful, systematic innovation begins with the analysis of the sources of new opportunities (Drucker, 1985). The business environment can be divided into two categories: micro-environment and macro-environment. From the perspective of micro-environment, enriching the company's own knowledge base through the integration of suppliers, competitors, and external knowledge sourcing is an effective way to increase company's innovativeness (Laursen and Salter, 2006; Lettl et al., 2006; Piller and Walcher, 2006). On the other hand, the macro-environment involves factors outside of the direct control of the business such as the economy, government policy and social change can have a significant effect on a company's innovation strategies (Gillespie, 2007).

Co-innovation means the collaboration between company's customers or users, or collaboration with other companies or universities and other knowledge-based

organizations to access external knowledge in order to innovate. In terms of collaborative innovation, market orientation has a significant positive influence on new product success and, consequently, and it is a crucial element of innovation management (Tomala and Senechal, 2004). Biemans (1990) suggests that cooperation, coordination, and communication reduce the level of chaos in an innovations process, and, thus, increases the probability of developing successful innovations. Therefore, innovation oriented organization needs to form collaborative networks and partnerships for successful innovations.

8. CONCLUSION

8.1 Implications

In today's hyper-competitive business world, companies are facing with brutal competition; market shares are decreasing due to globalization, customers' demand on individualization are increasing, time to market and uniqueness become more of an issue. To ensure competitive advantage, companies need to find ways to differentiate from the competitive environment by focusing on development new products, processes or services, providing the customer with increased functionality and performance.

Today more than ever before, the disruptive effects of emerging technologies, empowered customers, new market entrants, shorter product life cycles, geopolitical instability, and market globalization force companies to exploit their innovative capabilities to develop new businesses. Indeed, the development of innovative capabilities is obviously essential for companies to sustain a competitive advantage, and the capacity to manage innovation successfully is crucial for the competitive power of a company. As the importance of innovation increases for sustainable competitive advantage, innovation management concept has become the focal point of intensive academic and industrial research that aims to find ways for achieving sustainable competitive advantage in the global competition.

In the literature, the need for an innovation management framework is addressed and there are many studies conducted with the aim of development an innovation management framework in order to meet these needs. However, as confirmed by some academicians (e.g. Adams et al., 2006), a holistic framework for organization-wide innovation management has not been presented yet.

This paper aims to introduce a comprehensive and integrated framework for managing innovation at the organization-wide scale by using general system theory and axiomatic design methodology. This approach provides a systematic and scientific way in effective design of a framework for organization-wide innovation

management. The approach is considered as systematic since general system theory provides a theoretical foundation based on systematic perspective in order to determine the core components of the framework. In addition, the approach is considered as scientific since axiomatic design methodology provides a theoretical foundation based on logical and rational thought processes and tools in order to establish a scientific basis for design and to improve design activities for the proposed framework.

With the aim of validation of the framework, an empirical survey was conducted to collect data from companies in information and communication technologies industry in Turkey. Then, multiple regression analysis was employed on the basis of data collected from survey respondents. The framework of innovation oriented organization was validated by examining the impacts of the framework components on company innovation performance.

Based on the findings of the analysis, innovation oriented organization can be described as an organization that has a well-defined innovation process, operates in an innovation-friendly organizational infrastructure, performs supportive operations to facilitate innovation activities, and develops innovation-oriented relations with environmental actors.

Whereas most studies on critical success factors (such as Prahalad and Hamel, 1990) focus on the technological aspects of success factors, this study validates that the organizational and managerial aspects of innovation should not be undervalued in explaining the core components of innovation management. This study, therefore, highlights the importance of managerial and organizational aspects in addition to technological aspects.

In general, the proposed framework for organization-wide innovation management aims to guide companies how they could transform themselves into an innovation oriented organization by managing innovation process systematically and improving innovation competency continuously. In addition, it provides a useful reference for managers to understand key concepts and core components of innovation management within a big picture.

8.2 Limitations and Future Research

Although the proposed framework has been designed with the vision of covering all types of industries, this research has only been applied to the information and communication technologies industry in Turkey. To obtain a wider validity of the framework, similar studies should be employed across different industries or countries.

Future research may focus on building an innovation assessment model based on the framework developed in this research. By further assigning priority weights and developing the assessment check items and knowledge bases of good innovation management practices of each factor, the an assessment model can be developed in order to practically assist companies to monitor and evaluate their innovation management practices. Innovation assessment model may consist of methods and tools to evaluate the innovation capability of companies, in particular, for the identification of their strengths, the improvement of their potentials, and for a good basis for a sustainable improvement of the innovation capability.

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APPENDICES

APPENDIX A.1 : Survey Study
APPENDIX A.2 : Anket Çalışması
APPENDIX A.3 : Survey Invitation
APPENDIX A.4 : Anket Daveti

APPENDIX A.1

The questionnaire has been prepared and offered to you with the aim of validation of the critical success factors of the Innovation Management framework, which is designed after an extensive literature review.

SECTION-1: Innovation Competence of Company

In this section, there are questions querying the innovation competency level of your company.

1. Are innovation activities performed in your company?

Yes ☐ No ☐

2. Does your company try to systematize the innovation process?

Yes ☐ No ☐

3. Does your company try to measure the outputs of innovation activities?

Yes ☐ No ☐

SECTION-2: Evaluation of Core Components

In this section, there are questions querying the critical success factors related to innovation process.

In each question, you are asked to express your subjective assessment about the importance level and company accomplishment for the critical success factor.

Please note that the meaning of the answers is as follows:

1: Lowest Value

5: Highest Value

4. Collecting the innovative ideas systematically from different sources such as customers, employees, etc.

Factor Importance Level	1-☐	2-☐	3-☐	4-☐	5-☐
Company Accomplishment	1-☐	2-☐	3-☐	4-☐	5-☐

5. Conceptualizing projects from promoted ideas and analyzing their feasibility

Factor Importance Level	1-☐	2-☐	3-☐	4-☐	5-☐
Company Accomplishment	1-☐	2-☐	3-☐	4-☐	5-☐

6. Implementing the approved projects as conceptualized

Factor Importance Level	1-☐	2-☐	3-☐	4-☐	5-☐
Company Accomplishment	1-☐	2-☐	3-☐	4-☐	5-☐

7. Offering the implemented projects to customer in the right way

Factor Importance Level	1-☐	2-☐	3-☐	4-☐	5-☐
Company Accomplishment	1-☐	2-☐	3-☐	4-☐	5-☐

8. Following customer's feedback on the innovations offered

Factor Importance Level	1-☐	2-☐	3-☐	4-☐	5-☐
Company Accomplishment	1-☐	2-☐	3-☐	4-☐	5-☐

9. Learning from experience obtained during innovation process with the aim of improvement

Factor Importance Level	1-☐	2-☐	3-☐	4-☐	5-☐
Company Accomplishment	1-☐	2-☐	3-☐	4-☐	5-☐

In this section, there are questions querying the critical success factors related to innovation oriented organizational infrastructure.

In each question, you are asked to express your subjective assessment about the importance level and company accomplishment for the critical success factor.

Please note that the meaning of the answers is as follows:

1: Lowest Value

5: Highest Value

10. Defining corporate vision and strategies by focusing on innovation

Factor Importance Level	1-☐	2-☐	3-☐	4-☐	5-☐
Company Accomplishment	1-☐	2-☐	3-☐	4-☐	5-☐

11. Forming the structure of organization to foster innovation activities

Factor Importance Level	1-☐	2-☐	3-☐	4-☐	5-☐
Company Accomplishment	1-☐	2-☐	3-☐	4-☐	5-☐

12. Defining key enabling figures for managing innovation activities

Factor Importance Level	1-☐	2-☐	3-☐	4-☐	5-☐
Company Accomplishment	1-☐	2-☐	3-☐	4-☐	5-☐

13. Integrating innovation culture into the corporate culture

Factor Importance Level	1-☐	2-☐	3-☐	4-☐	5-☐
Company Accomplishment	1-☐	2-☐	3-☐	4-☐	5-☐

14. Enabling innovation spread throughout the organization

Factor Importance Level	1-☐	2-☐	3-☐	4-☐	5-☐
Company Accomplishment	1-☐	2-☐	3-☐	4-☐	5-☐

15. Designing work climate to promote creativity and innovation

Factor Importance Level	1-☐	2-☐	3-☐	4-☐	5-☐
Company Accomplishment	1-☐	2-☐	3-☐	4-☐	5-☐

In this section, there are questions querying the critical success factors related to supportive systems and environmental relations.

In each question, you are asked to express your subjective assessment about the importance level and company accomplishment for the critical success factor.

Please note that the meaning of the answers is as follows:

1: Lowest Value

5: Highest Value

16. Encouraging employees to contribute innovation activities

Factor Importance Level	1-☐	2-☐	3-☐	4-☐	5-☐
Company Accomplishment	1-☐	2-☐	3-☐	4-☐	5-☐

17. Hiring qualified employees and building company loyalty

Factor Importance Level	1-☐	2-☐	3-☐	4-☐	5-☐
Company Accomplishment	1-☐	2-☐	3-☐	4-☐	5-☐

18. Developing employee competence for required skills

Factor Importance Level	1-☐	2-☐	3-☐	4-☐	5-☐
Company Accomplishment	1-☐	2-☐	3-☐	4-☐	5-☐

19. Utilizing the technology to support and facilitate innovation activities

Factor Importance Level	1-☐	2-☐	3-☐	4-☐	5-☐
Company Accomplishment	1-☐	2-☐	3-☐	4-☐	5-☐

20. Creating knowledge internally or acquiring it externally, and enabling knowledge accessible to all employees

Factor Importance Level	1-☐	2-☐	3-☐	4-☐	5-☐
Company Accomplishment	1-☐	2-☐	3-☐	4-☐	5-☐

21. Monitoring customer needs, market trends, competitor actions and macro-environmental changes

Factor Importance Level	1-☐	2-☐	3-☐	4-☐	5-☐
Company Accomplishment	1-☐	2-☐	3-☐	4-☐	5-☐

22. Performing innovation activities with the external actors such as customers, co-operators, etc.

Factor Importance Level	1-☐	2-☐	3-☐	4-☐	5-☐
Company Accomplishment	1-☐	2-☐	3-☐	4-☐	5-☐

SECTION-3: Company Accomplishment in Terms of Performance Criteria

In this section, there are questions querying the innovation performance level of your company.

In each question, you are asked to express your subjective assessment about the accomplishment level of your company in terms of the innovation performance indicator.

Please note that the meaning of the answers is as follows:

1: Lowest Value

5: Highest Value

Note: Consider the last three years while answering the questions.

23. Number of new products and services offered

Company Accomplishment 1-☐ 2-☐ 3-☐ 4-☐ 5-☐

24. Customer satisfaction from new products and services offered

Company Accomplishment 1-☐ 2-☐ 3-☐ 4-☐ 5-☐

25. Return on innovation investment

Company Accomplishment 1-☐ 2-☐ 3-☐ 4-☐ 5-☐

26. Revenue growth gained from innovative solutions offered

Company Accomplishment 1-☐ 2-☐ 3-☐ 4-☐ 5-☐

27. Cost reduction resulted from innovative solutions offered

Company Accomplishment 1-☐ 2-☐ 3-☐ 4-☐ 5-☐

28. Effectiveness and diversity of channels to collect ideas

Company Accomplishment 1-☐ 2-☐ 3-☐ 4-☐ 5-☐

29. Time to offer innovative solutions to market

Company Accomplishment 1-☐ 2-☐ 3-☐ 4-☐ 5-☐

SECTION-4: Overall information about participant

In this section, you are asked to share your personal information in order to inform you about the results of this study.

30. Name of the participant

31. Company of the participant

32. Comments on the survey

APPENDIX A.2

Ankette yer alan sorular, akademik çalışma sonucunda tasarlanan İnovasyon Yönetim Sistemi Modeli'nin dayandığı kritik başarı faktörlerinin geçerliliğini araştırmak üzere hazırlanmış ve sizlerin değerlendirmelerinize sunulmuştur.

BÖLÜM-1: Kurumun İnovasyon Yetkinliği

Bu kısımda, kurumunuzun inovasyon konusundaki genel yetkinliği ile ilgili sorular yer almaktadır.

1. Kurumunuzda inovasyon faaliyetleri gerçekleştiriliyor mu?

Evet ☐ Hayır ☐

2. Kurumunuzda inovasyon sürecini sistematik hale getirmeye yönelik çalışmalar gerçekleştiriliyor mu?

Evet ☐ Hayır ☐

3. Kurumunuzda inovasyon faaliyetlerinin sonuçlarını ölçümlemeye yönelik çalışmalar gerçekleştiriliyor mu?

Evet ☐ Hayır ☐

BÖLÜM-2: Temel Faktörlerin Değerlendirilmesi

Bu kısımda, inovasyon sürecine ilişkin kritik başarı faktörleri ile ilgili sorular yer almaktadır.

Her soruda ifade edilen kritik başarı faktörünün önem derecesini ve kurumunuzun bu faktördeki başarı seviyesini 'kişisel değerlendirmenize göre' belirtmeniz istenmektedir.

Soruların altında yer alan cevap seçenekleri şu şekildedir:

1: En Düşük Değer

5: En Yüksek Değer

4. Yaratıcı fikirlerin çalışan, müşteri vs. gibi farklı kaynaklardan sistematik şekilde toplanması

Faktörün Önem Derecesi	1-☐	2-☐	3-☐	4-☐	5-☐
Kurumun Başarı Seviyesi	1-☐	2-☐	3-☐	4-☐	5-☐

5. Kurum stratejilerine uygun olan fikirlerden projeler tasarlanması ve fizibilite çalışmalarının yapılması

Faktörün Önem Derecesi	1-☐	2-☐	3-☐	4-☐	5-☐
Kurumun Başarı Seviyesi	1-☐	2-☐	3-☐	4-☐	5-☐

6. Değerlendirme işlemi sonucunda onaylanan projelerin hayata geçirilmesi

Faktörün Önem Derecesi	1-☐	2-☐	3-☐	4-☐	5-☐
Kurumun Başarı Seviyesi	1-☐	2-☐	3-☐	4-☐	5-☐

7. Hayata geçirilen projelerin müşteriye uygun şekilde sunulması

Faktörün Önem Derecesi	1-☐	2-☐	3-☐	4-☐	5-☐
Kurumun Başarı Seviyesi	1-☐	2-☐	3-☐	4-☐	5-☐

8. Müşteri kullanımına sunulan yenilikçi çözümler ile ilgili geri bildirimlerin takip edilmesi

Faktörün Önem Derecesi	1-☐	2-☐	3-☐	4-☐	5-☐
Kurumun Başarı Seviyesi	1-☐	2-☐	3-☐	4-☐	5-☐

9. İnovasyon süreci boyunca elde edilen bilginin sürecin iyileştirilebilmesi yönünde kullanılması

Faktörün Önem Derecesi	1-☐	2-☐	3-☐	4-☐	5-☐
Kurumun Başarı Seviyesi	1-☐	2-☐	3-☐	4-☐	5-☐

Bu kısımda, inovasyon odaklı organizasyonel yapılanmaya yönelik kritik başarı faktörleri ile ilgili sorular yer almaktadır.

Her soruda ifade edilen kritik başarı faktörünün önem derecesini ve kurumunuzun bu faktördeki başarı seviyesini 'kişisel değerlendirmenize göre' belirtmeniz istenmektedir.

Soruların altında yer alan cevap seçenekleri şu şekildedir:

1: En Düşük Değer

5: En Yüksek Değer

10. Kurum vizyonunun ve stratejilerinin inovasyon odaklı olarak tanımlanması

Faktörün Önem Derecesi	1-☐	2-☐	3-☐	4-☐	5-☐
Kurumun Başarı Seviyesi	1-☐	2-☐	3-☐	4-☐	5-☐

11. Organizasyon yapısının inovasyon sürecini destekleyecek ve etkinleştirecek biçimde oluşturulması

Faktörün Önem Derecesi	1-☐	2-☐	3-☐	4-☐	5-☐
Kurumun Başarı Seviyesi	1-☐	2-☐	3-☐	4-☐	5-☐

12. İnovasyon faaliyetlerinin yönetiminden ve koordinasyonundan sorumlu kişilerin ve görev tanımlarının belirlenmesi

Faktörün Önem Derecesi	1-☐	2-☐	3-☐	4-☐	5-☐
Kurumun Başarı Seviyesi	1-☐	2-☐	3-☐	4-☐	5-☐

13. İnovasyon kültürünün oluşturulması ve kurum kültürüne kazandırılması

Faktörün Önem Derecesi	1-☐	2-☐	3-☐	4-☐	5-☐
Kurumun Başarı Seviyesi	1-☐	2-☐	3-☐	4-☐	5-☐

14. Üst yönetim tarafından inovasyon sisteminin sahiplenilmesi ve yayılımının desteklenmesi

Faktörün Önem Derecesi	1-☐	2-☐	3-☐	4-☐	5-☐
Kurumun Başarı Seviyesi	1-☐	2-☐	3-☐	4-☐	5-☐

15. Çalışma ortamının inovasyon iklimini destekleyecek şekilde tasarlanması

Faktörün Önem Derecesi	1-☐	2-☐	3-☐	4-☐	5-☐
Kurumun Başarı Seviyesi	1-☐	2-☐	3-☐	4-☐	5-☐

Bu kısımda, inovasyon yönetimi için gerekli destekleyici sistemlere ve çevresel ilişkilere yönelik kritik başarı faktörleri ile ilgili sorular yer almaktadır.

Her soruda ifade edilen kritik başarı faktörünün önem derecesini ve kurumunuzun bu faktördeki başarı seviyesini 'kişisel değerlendirmenize göre' belirtmeniz istenmektedir.

Soruların altında yer alan cevap seçenekleri şu şekildedir:

1: En Düşük Değer

5: En Yüksek Değer

16. Ödüllendirme sistemi gibi mekanizmalar ile çalışanların inovasyon sürecine katılımlarının teşvik edilmesi

Faktörün Önem Derecesi	1-☐	2-☐	3-☐	4-☐	5-☐
Kurumun Başarı Seviyesi	1-☐	2-☐	3-☐	4-☐	5-☐

17. Nitelikli insan kaynağının kuruma kazandırılması ve kurumsal bağlılığının geliştirilmesi

Faktörün Önem Derecesi	1-☐	2-☐	3-☐	4-☐	5-☐
Kurumun Başarı Seviyesi	1-☐	2-☐	3-☐	4-☐	5-☐

18. Çalışanların bilgi, beceri ve kişisel özellik ile ilgili yetkinliklerinin geliştirilmesi

Faktörün Önem Derecesi	1-☐	2-☐	3-☐	4-☐	5-☐
Kurumun Başarı Seviyesi	1-☐	2-☐	3-☐	4-☐	5-☐

19. Kurum içi iletişimi ve bilgi paylaşımını etkinleştirmek üzere bilgi ve iletişim teknolojilerinden faydalanılması

Faktörün Önem Derecesi	1-☐	2-☐	3-☐	4-☐	5-☐
Kurumun Başarı Seviyesi	1-☐	2-☐	3-☐	4-☐	5-☐

20. Bilgi Yönetimi faaliyetlerinin sistematik şekilde gerçekleştirilmesi

Faktörün Önem Derecesi	1-☐	2-☐	3-☐	4-☐	5-☐
Kurumun Başarı Seviyesi	1-☐	2-☐	3-☐	4-☐	5-☐

21. Müşteri ihtiyaçlarının, pazar eğilimlerinin ve çevresel (teknolojik, sosyal, ekonomik) gelişmelerin takip edilmesi

Faktörün Önem Derecesi 1-☐ 2-☐ 3-☐ 4-☐ 5-☐

Kurumun Başarı Seviyesi 1-☐ 2-☐ 3-☐ 4-☐ 5-☐

22. Müşterilerin ve iş ortaklarının inovasyon sürecine katılımının sağlanması

Faktörün Önem Derecesi 1-☐ 2-☐ 3-☐ 4-☐ 5-☐

Kurumun Başarı Seviyesi 1-☐ 2-☐ 3-☐ 4-☐ 5-☐

BÖLÜM-3: Performans Göstergelerine Göre Şirketin Başarı Durumu

Bu kısımda, organizasyonel inovasyon yönetiminin ölçümlenebilmesi için belirlenen performans göstergeleri ile ilgili sorular yer almaktadır.

Her soruda ifade edilen performans göstergesi açısından kurumunuzun başarı seviyesini kişisel değerlendirmenize göre belirtmeniz istenmektedir.

Soruların altında yer alan cevap seçenekleri şu şekildedir:

1: En Düşük Değer

5: En Yüksek Değer

Not: Değerlendirmede bulunurken son üç yıllık dönemi dikkate alabilirsiniz.

23. Kullanıma sunulan yeni ürün ve hizmet sayısı

Kurumun Başarı Seviyesi 1-☐ 2-☐ 3-☐ 4-☐ 5-☐

24. Kullanıma sunulan yeni ürün ve hizmetlere ilişkin müşteri memnuniyeti

Kurumun Başarı Seviyesi 1-☐ 2-☐ 3-☐ 4-☐ 5-☐

25. İnovasyondan elde edilen kazancın yapılan yatırıma oranı

Kurumun Başarı Seviyesi 1-☐ 2-☐ 3-☐ 4-☐ 5-☐

26. Kullanıma sunulan yeni ürün ve hizmetlerin sağladığı gelir artışı

Kurumun Başarı Seviyesi 1-☐ 2-☐ 3-☐ 4-☐ 5-☐

27. Geliştirilen inovasyonların kuruma sağladığı maliyet tasarrufu

Kurumun Başarı Seviyesi 1-☐ 2-☐ 3-☐ 4-☐ 5-☐

28. Fikir toplamak için kullanılan kanalların çeşitliliği ve etkinliği

Kurumun Başarı Seviyesi 1-☐ 2-☐ 3-☐ 4-☐ 5-☐

29. Uygun fikirlerin projelendirilip hayata geçirilme süresi

Kurumun Başarı Seviyesi 1-☐ 2-☐ 3-☐ 4-☐ 5-☐

BÖLÜM-4: Katılımcı hakkında genel bilgiler

Bu kısımda, anket sonuçları ile ilgili size geri dönüş yapılabilmesi için kişisel bilgilerinizi paylaşmanız istenmektedir.

30. Katılımcının ismi

31. Katılımcının görev aldığı şirket

32. Anket ile ilgili yorumlar

APPENDIX A.3

Welcome,

We have been performing an academic study about the subject of 'Innovation Management System' in ITU Faculty of Management.

A survey study is in progress in order to investigate the validity of 'Model of Innovation Management System' which is introduced as part of this academic study. With this purpose, we need you to share your valuable knowledge and experience in terms of innovation concept.

This survey invitation has been sent to 350 business professionals in information and communication technologies industry. Questions are designed in the way that can be completed in 10-15 minutes.

Please make sure that your responses will be used only within this academic study, and they will be evaluated as part of total responses.

You can access the survey through this link: http://inovasyon.questionpro.com/

If you need to know any information about the academic study or survey study, you can contact us via the e-mail 'burakkuzucu@gmail.com'.

We would like to thank you for your participation. With our best regards,

Prof. Dr. Cengiz Gungor - Y.L. Ogr. Burak Kuzucu

APPENDIX A.4

Merhabalar,

İstanbul Teknik Üniversitesi İşletme Fakültesi dahilinde 'İnovasyon Yönetim Sistemi' konusu üzerine bir akademik çalışma gerçekleştirmekteyiz.

Bu çalışma kapsamında ortaya konulan 'İnovasyon Yönetim Sistemi Modeli'nin geçerliliğini araştırmak üzere bir anket çalışması yapılmaktadır. Bu doğrultuda, sizin inovasyon konusundaki çok değerli bilgilerinize ihtiyaç duymaktayız.

Ankete katılım daveti, bilgi ve iletişim teknolojileri sektöründe görev alan yaklaşık 350 kişiye gönderilmiştir. Sorular, yaklaşık olarak 10-15 dakika arasında tamamlanabilecek şekilde tasarlanmıştır.

Ankete vereceğiniz cevaplar sadece bu akademik çalışma dahilinde kullanılacak olup gelen tüm cevaplar içerisinde bütünsel olarak ele alınacaktır.

Ankete şu adres üzerinden erişebilirsiniz: http://inovasyon.questionpro.com/

Araştırma ve anket çalışması ile ilgili bilgi almak istediğiniz tüm konular için, burakkuzucu@gmail.com elektronik posta adresi üzerinden bizimle iletişime geçebilirsiniz.

Katılımınızdan dolayı teşekkürlerimizi sunarız. Saygılarımızla,

Prof. Dr. Cengiz Güngör - Y.L. Öğr. Burak Kuzucu

CURRICULUM VITA



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