

A Comprehensive Analysis Through Innovation Systems, National R&D Approaches and Design Support Programs

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Abstract In many countries, the transformation process of ideas and inventions in high and low technology industries into products having perceptible utilities by specialized programs, are being supported by governments. Technology development and innovation policies that are designed in the light of these efforts frequently contain invention, R&D, product development and innovation processes that have important roles in design activity. This research collates various national apprehensions and attempts considering the interaction between design, innovation and R&D activities under the sway of technological changes and social trends through the 20th century. Exploring the common senses attributing the subject activities by striking popular definitions and experiences, actual and eligible deductions are ensured. The study shows that national level attempts are carrying on their continuous evolutions for the satisfaction of the constantly changing requirements of societies. The success displays of many developed countries point out that innovation process have entirely adapted to national policy structures through the aim of increasing the national competition level, R&D can be betrayed as a fundamental activity supporting innovation and design could be defined as a genuine and central component and a basic competitive factor of innovation process.

Keywords Innovation Policy, Design Supports, National Innovation System, Technological Change, Industrial Design, R&D

1. Introduction

By having a short outlook through the recent decades, it can be stated that there is a notably intensive and multidimensional relationship between design, innovation and R&D activities. Considering the technological changes and social trends in the 20th century, various definitions and development models representing design and innovation processes are introduced. The scope of this study is to prosecute a comparative analysis through various national political approaches by dealing with distinctive design, innovation and R&D definitions that are significative in the study area; and fundamental national perceptions and policy production approaches.

The highest added value is developed in cultivation; and this is followed respectively by services and industry in a developing country. In industrializing countries, the highest added value is seen in industry, followed by services and cultivation in return. Meanwhile in highly industrialized countries, the added value creation rate is observed in order of services, industry and cultivation. Here the underlined spot should be that the development of services is a result of

development in industry. In the present age, societies and management staff that are assimilated by the conditions and requirements of near future are intensifying on infrastructures transforming knowledge to product and commercial success in order to increase the added value in services. According to an aspect that can be adapted to the whole society, “the majority of industry firms are improvised for global competition. While the existing sectors are being conserved, it is clear that they should insert much more added value to their products and services. Inserting added value can only be possible by the transformation of knowledge to product.”[1]

Political decisions meeting social and economical prospects of today's societies by increasing employment or accelerating regional developments, education programs based on sustainability, activities like electronic service applications are frequently seen in countries aiming to implement innovation process on national policies.

In many countries, the transformation process of ideas and inventions generated in various high and low technology industries into products having perceptible utilities by specialized programs, are being supported by governments. In order to identify this process based on developments in industries and services more efficient, ‘design’ ‘innovation’ and ‘R&D’ definitions and the interrelation of them are cross-examined in this study.

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2. Definitions and Interaction: Design, R&D and Innovation

Innovation referring to an economic and social system depending on diversification and alteration as a result is broadly defined as “transformation of knowledge to economical and social benefit”. [2] Therefore; technical, economic and social processes constitute a whole. Innovation process cannot be abstracted from other commercial or social activities that it is in interaction, while being carried out in the content of an activity. Therefore, innovation activity necessitates an approach basing upon integrity and sustainability. Cox report prepared in England in 2005 in order to provide performance rise in production by creativeness defines innovation as “Successful use of new ideas for certain objectives.” [3] In the report, it is stated that this process is resulted by new products, new services, new management strategies, and also new occupations. In the information report of NESTA (National Endowment for Science, Technology and the Arts), the ‘Policy and Research Unit’ that informs and orients young firms about future problems, defines innovation as ‘activities satisfying needs by new methods’. The same report also highlights that innovation is determined by R&D, which is the basic source of value creation in traditional means. For NESTA, innovation is more than products and inventions emerging as results of scientific and technological researches. [4]

According to the 2009 published report of ‘Commission of the European Communities’ which is the support and audit structure of United Nations (UN) developing laws and regulations, applying the decisions and supporting the agreements of UN; innovation is a process that can be defined as ‘the successful usage of new ideas transforming new ideas to new products, new services, new management methods and also new business methods.’

For the ‘Least Developed Countries Report’ that was published in 2007 as the scope of ‘United Nations Conference on Trade and Development’ (UNCTAD) evaluating technological innovation data in least developed countries, innovation is primarily seen in technologically developed countries. For ‘The Community Innovation Survey (CIS) of England’s Ministry of Business, Innovation and Skills (BIS) which gives enterprising service to SME’s and quantify the innovation performances of European Union countries in 2004 – 2006; the enterprise performing the innovation activity is not important. Any innovation can be new for an initiative; however, it doesn’t have to be new in a sector or market. [5] The innovation types and definitions in CIS, are stated below:

→ **Product innovation** is the incorporation of a new product or service, or a substantially improved product or service to market.

→ **Process innovation** is the implementation of a substantially improved production process, distribution method or support activity for products and services.

→ **Organizational innovation** is the implementation of new or substantial changes about the firm structure or

management methods aiming to increase the efficiency of the firm’s use of knowledge, product and service quality, or business flow. This type of innovation can also be defined as ‘the implementation of a new organizational method covering the firm’s business activities, study area organization and external relationships’.

→ **Marketing innovation**, is the implementation of new or substantially improved design or disposition methods aiming to increase the desirability of products and services or to ensure entering new markets. In marketing innovation, a new marketing method concerning product design or packaging, product promotion or pricing, can be implemented.

Innovation includes all the processes aiming to develop a new or substantially improved product, service or process, and makes this provide a commercial advantage. Therefore the generated, operated and commercialized ideas and outcomes have to be evaluated scores of times. Afterwards, these outcomes should be used universally for new proceeds. Consequently, the new ideas would provide new innovation activities. [6] As well as highlighting the importance of sustainability in innovation process, this definition is also evaluated as the most extensive one amongst the examined statements in the literature and defined as the definition that this study is based on.

Frascati manual that is accepted to be a standard for all R&D reviews in the literature defines R&D as a systematic concept aiming to increase the knowledge fund and to develop new usage areas containing human, culture and society knowledge; do not have to be eventuated by an invention, despite of being fed from new ideas and inventions. [7]. Tether points out R&D as a main source to functionalize new technologies. [8] In the scope of CIS, R&D is the enhancement of the knowledge stock, and use of knowledge in designing new and improved products and processes. [9] For Frascati manual, R&D is an activity related with many other activities having scientific and technological basis. However, these activities are closely related with R&D, they should be evaluated apart from R&D indications in the means of knowledge flows and companies, institutions and personnel. Despite absolutely being a part of innovation process, it should be defined independent from patent process for production operation and licensing, market research, initial step of production preparation of production equipment and redesign activities that include R&D very rarely. [10] The relationship of R&D activity with other activities playing role in innovation process, is denied in NESTA (2008) report as follows: “Technological R&D should be anchored to existing platforms and focused to the incremental developments on these platforms.” This kind of an approach may increase the innovation performance or reduce the costs, however, it would not cause the basic change that is frequently needed for staying competitive. This required basic change could only be possible by design activity that ensures a user-focused product development process in all industries, and situates at the centre of

innovation process. The approach in Frascati manual that defines R&D process parallel to the changing period of technology independently from needs, has made the internalized definition of R&D in the flow of this study.[11]

Design activity that is defined as the transformation process of technology and knowledge to useable products (Er, 2001), is an activity carried out both in high-tech and low-tech industries. For Er, design activity aiming to develop suitable products for user needs and regards, has more commercial success chance than product development activities that don't rely on market needs.[12]

For the assignment of Von Stamm[13] that defines design as 'conscious decision-making process intended for transforming an idea into an output as a product or a service', 11 design definitions can be met in 'The Concise Oxford Dictionary', and 33 in 'The British Encyclopaedia'. [14]

In the 2005 report published by DTI, which is carrying out activities to support entrepreneurship and creativeness[15], design is defined as 'an important competitive tool for firms in all sectors'. Bessant et.al. define design as implementation of creativeness to all activities that are necessary for ideas produced in scope of product or process innovation.[16]

Design, which is defined as a critical competitive tool for its ability to entirely diversify the products, is also identified broadly as 'the optimization of market and technology sourced opportunities by pursuing the correlative benefits of producer and user on the base of product/service.[17] 'Design Policy' concept that is generated through the systematic operation of national design activities, is defined as 'systematic government efforts aiming the development of national design resources and reinforcement of the productive use of these resources by firms in order to increase the national economic advantage in international markets.'[18]

Technology development and innovation policies that are designed in the light of these arguments frequently contain invention, R&D, product development and innovation processes that have important roles in design activity.

As it is stated in NESTA report, innovation as a linear model; involves R&D, new inventions on products and processes and finally the output is offered to the customer.[19] Because of this stated manner, R&D is used as a determinative factor for the innovation performances of firms and countries. Besides, design activity that is stated to be at the centre of innovation activities in the literature, undertakes a formative role on innovation and R&D activities in the product development process. That is because design activity is user and need focused besides being in close interaction with many activities and processes. For Er, design as the centre of innovation process and a substantive tool through innovation, is an activity more extensive than invention and innovation; and also more widespread than R&D.[20] Through the definitions and sights above, it can be stated that design – innovation and R&D are in a substantially complex contamination owing to its extent.

In the recent epoch with the effect of changing requirements and increasing expectations in local, sectoral and national base; design and other non-pricefactors acquired much more significance for being exhibited by its continuous and efficient contributions to competitive strength. Here, it can clearly be seen that it is inadequate to evaluate innovation, which determines the global countenance and has become a forcing power of improvement, by only technological innovation originated. All types of innovation having capability to cover user needs, can be defined as design innovation.[21][22]

That design activity is in close relationship with product-user interaction and user expectations; it contributes to marketing and production processes more pervasive and effective. As the fundamental reason of this situation, it can be stated that design aims and decisions have a function of displaying and evaluating the technical improvements and produced knowledge recorded by invention and innovation processes; by effecting the expenditure, sales price, shelf life and after sales service.

At this step of the study, it would be useful to define design activity engaged with the other activities through the innovation process, in order to present its interactive relationship with innovation policies and systems. For Cox Report, design is the connector agent of creativity and innovation. It transforms ideas into practical and attractive offerings for customers and consumers. Design can be defined as "creativity planned for a particular end".[23] This process of transformation of technologic developments and knowledge into useable products that can be interpreted as an essential component in accessing innovation, is defined by Er and Er as stated below:

With the broadest content, design can be defined as the optimization of market and technology sourced opportunities by overseeing the correlative benefits of the producer and the user at product / service base. In other words; it is the planning action of a product that is satisfying a need that a firm has determined in the market, by providing a reasonable profit to its producer at the end. Therefore design aims to assemble the technological input and market data in the base of a new or improved product / service.[24]

This optimization process mentioned above proves the distinctive role of design in the competitive economy and contributions to the innovation governance process. Optimizing the correlative benefits can be commented as one of the main statements that industrial design process is based upon. It can be mentioned that this definition entirely encompasses the interrelation between government, private sector, university and research institutes in the content of design support programmes.

However, technological change and development of design processes are activities continuously proceeding through time, it is feasible to make a differentiation between the methods of their proceedings. While technological changes resume their linear progressions without a necessity for a need to trigger these activities, developments in design

always eventuate as results of needs such as production, usage and marketing.[25]

An important distinction between the linear change of technology and the development model of design process can be stated as the limited validity of some new technologies because of newer technologies produced in the continuing process, that cause many new technologies lose their availabilities. On the other hand, correlations of universal design criteria like functionality, user safety, conceptual stability and ergonomic infrastructure directly with needs and user expectations; can be indicated as to be the reason for chronic consistency of design values.

For interrogating the relationship of the effects of an invention eventuated in technology with the usage method of technology in design process, it would be helpful to evaluate the meaning of a technological development or invention in R&D process. We can classify the reactions for a new invention in two groups:

→ Installation of the technology to the existing scheme

→ Redesigning the scheme according to the outcomes of the technology[26]

Departing for this view, it can be submitted that R&D process is in relationship with technological innovation. However, technological innovation cannot be a prerequisite for design activity. Design as a central activity of innovation process, can be carried out intensively in processes that don't include R&D and in low-tech industries.[27] Various countries internalizing this situation have generated design support programs having the capacity to provide design activity penetrate into all policy structures and professional activities related to R&D, product development and innovation processes.

In the light of the statements above, by examining the technology and innovation policies of various countries, it would be possible to evaluate social expectations and judgement, and also the success probabilities of management staff through particular visions and proposed targets. Supporting this approach, in the next chapter, social and economic reasons regarding the use of 'innovation', 'R&D' and 'design' activities in national policies; and the circumstances of generating these policies, will be discussed with the help of certain principal theories affecting the generation processes of innovation and design policies.

3. Design, Innovation and R&D in National Policies

In spite of being one of the popular concepts in the recent epoch, 'Innovation Policy' focuses on enlarging the industry, for preserving the existing competition advantages or acquiring new advantages. Countries aim to generate and perform suitable policies for their local conditions through the improvement of their societies. While some countries internalize models bottomed on SME's or large companies, some others regard direct foreign investment. As a common

viewpoint of these studies are found to be as 'working up innovation into the pushing force of improvement'.[28]

Here, it would be helpful to introduce the definitions of 'policy', 'innovation policy' 'design policy' contexts and their relationship among themselves. Especially in the second half of the late century, the policy decisive structures of many economically improved countries and international organizations have concentrated on the ways of improving the innovation capacities of sectors and the factors of this improvement. The OECD Growth Study, published in 2002, has highlighted the relationship between innovation and economic performance and defined the outlines of some general proposals for innovation policy.

Since 1980s, both OCED's recommendations that are valid for all countries and common motives of the national innovation policies of EU countries have been relied on a certain theoretical basis. For Taymaz, there are two important economic theorems that are effective on generating technology and innovation policies: The neo-classical theorem and Schumpeterian / evolutionist theorem. Despite being the dominant inclination in economy, neo-classical theorem has fallen behind in technology and innovation economy and had left its leading role to Schumpeterian / evolutionist theorem after the 1980s.[29]

The Schumpeterian / evolutionist economists have suggested that neo-classic approach is inadequate in encompassing the process and consequently it could not contribute to the generation of technology policies. Evolutionist approach has grown up in technology and innovation economy after the 'Evolutionist Theory of Economical Growth' book of Nelson and Winter, published in 1982. This approach evaluates technological innovation as the motor of improvement based on Schumpeter's studies; therefore technological innovation process has a pivotal role in evolutionist analysis.[30]

Nowadays in the speedily developing competitive stage, the organizations constituted through government and government policies are showing massive efforts to generate competitive knowledge-based economies in both national and international scales. The reason for this can be stated as the effectiveness of innovation for nations in warranting employment augmentation, sustainable development and life quality. The characteristic future of national innovation policies is the systematic approach to perfection in innovation and maintenance of this gained perfection. The systematic approach to innovation is analysed below in detail:

Various studies are carried out by academic and political periphery for explaining the economic reasons of the necessity of financially supporting the dissemination of R&D and innovation by the public.[31]

The Innovation Outlook (GIO) report whose aim is defined as 'determining the motivation factors behind substantive changes for individuals, enterprises and the whole world other than predicting the future', innovation is stated as increasingly;

- Global; that the limits of geographic accessibility are removed by network technologies and open standards, and that everyone could be included in the economic system based on innovation;

- Multidisciplinary; that the factors being faced and have to be coped with are much more complex structures anymore, therefore innovation requires specialities on different disciplines and abilities;

- Collaborator and definite; it is seen that innovation is emerged from the labours of individuals that work together and integrated.[32]

It has come into prominence defining design activity as a specified policy through the scope of the system sheltering the multi disciplinary and integrated individuals mentioned above.

The innovation policy generation conditions of many industrialized and industrializing countries are emerged by the proceeding of policy generation system as a result of textures peculiar to democracy, such as freedom for judgmental approach, parliamentary audit and supremacy of jurisprudence. Through the next sequences, the formation of National Innovation System and the systematic approach to innovation will be discussed as well as design support programs being performed in the scope of innovation policies or specified design policies.

4. Generation and Development of Innovation Policy

Nations give massive importance to the producing, acquiring, using and disseminating technologies for increasing revenue levels of countries, life qualities of societies and directing their social and governmental policies. Here the basic aim is reaching the determined innovation capacity by establishing an impact scientific infrastructure. In the conditions of our age, the most prevalently accepted way of attaining these aims is the generation and operation of National Innovation System.

Designing science and technology policies or producing techno economic strategies have been used and are being used as a tool for attaining the social and political targets. "This circumstance is not a new phenomenon. The history of these kind of approaches and practices date back to 18th century. Since the English Industrial Revolution, every country initializing industrialization have determined targets as reaching to the technology and acquiring competence in technology".[33]

After the 2nd World War, many nations primarily concentrating on technological changes and scientific researches, have headed towards studies on innovative product development by focusing their efforts on social expediency. Asian countries like South Korea, Taiwan and Malaysia that have begun industrialization process from low levels in 1950s, have been classified as 'very fast improving industrializing countries' with Latin American countries like

Brazil in 1960s and 70s by stable government policies regarding innovation.

In 1980s, while the East Asian countries continue their development with a higher acceleration, the developing Latin American countries have lost speed in industrialization by a general recession drift. This circumstance caused a rapid decline in their national incomes. The most important reasons for the difference between East Asian and Latin American countries are indicated as the social changes in some Asian countries like land reform and universal education, and also the basement that is fixed by these changes to important structural and technical transformations.[34]

In 1980s when the main factors of production in global economy are transformed from land, national resources and human stock into technology and intellectual fund, the two famous economists of our age: Cristopher Freeman and Bengt-Åke Lundvall have developed the 'National Innovation System (NIS)' concept which provides opportunity to analyse industrial structures, natural resources, development dynamics and collaborations, education inputs and labour force in a country.[35] For Pan, NIS is the key for technology and knowledge flow between companies and institutes, and the innovative process in national level.[36] This change in innovation and technology is the result of a network of complex relationships in the system where the actors are firms, universities and governmental research institutes. For famous economists Parimal Patel and Keith Pavitt, NIS can be defined as "national organizations determining the speed and direction of learning technology (or mass and composition of the activities that have generated the change), the support mechanisms and expertizes of these companies".[37]

The term 'National Innovation System' has begun to be used widespread in the generation of technology and innovation policies especially in 1990s. While encompassing all the establishments that affect the technological development process, on the other hand, acted effectively by bringing on its position in the international division of labour and international competitive strength of a country.[38]

For a healthy execution of National Innovation System; it should be in harmony and interaction with legal and institutional arrangements foreseen by various sectoral policies, science, technology and innovation policies. Only under these conditions, it could be possible to make many corporations and organizations that the system includes, operate in a systemic integrity.

5. Systematic Approach in Innovation and Contents of Innovation Policies

In 'European Trend Chart on Innovation 2003', it is reported that every NIS the structure of National Innovation System consists of two determinative factors that effect the innovation capacity. The first factor is being defined as the

structural and economical characteristic specialties like the dominance of SMEs in the economy, and the sectoral dispersion of activities according to sectors and demand to innovation. The second determinative factor can be defined as the socio-cultural and institutional conditions that support individuals, entrepreneurs and sectoral employee about innovation.

Systematic approach in innovation contains both the production of knowledge and the diffusely application processes. Therefore, the policy focus holds on the interaction between institutions. 'National Innovation System' refers to this whole of institutes and the dynamic system defining the knowledge; finance and regulation flow between them.

The main actors of National Innovation System are,

- Governments generating and performing the policies
- Firms in all sectors
- Organizations acting as bridges between government, firms, universities and research institutes.
- Universities
- Research institutes; and
- Patent offices, common research centres, technology transfer units, education centres, techno parks and other public and private sector foundations.[39]

'Innovation Policy' concept has been focused on innovation, changing of firms and development of their long term professional attitudes; and improvement of competitiveness and incomes. In this sense, innovation activities meet with success in direct proportion with the strength and quality of network between units constituting the system.

Bearing from the fact that innovation is not a linear process deriving from science and R&D, it is indicated that innovation is associated with all related policies like economy, industry, education, competition, SME, science and technology and environment policies, and it constitutes the centre of them.[40] Innovation governance that is a well designed and effective management type is necessary for the determination and application of innovation policies.

Most arguments on innovation policy are based on Paul Stoneman's definition. Stoneman defines innovation policy as 'policies including the intervention of government on the economy and aiming to affect the technological innovation process.[41] The positions of innovation policy for different national views differentiate; however, their contexts are prepared by the coordination of ministries responsible for industrial policies and ministries related with science and research. The applications of these policies are generally performed by grant programs organized by fund providing foundations and various supports about industrial innovation.

6. Structure, Validity and Necessity of Design Support Programs

Traditional production function has lost its validity in today's industry by the transfer of competition mainly to source and target areas. As a result of this case, many industrial foundations have changed their focus areas; and the firms located in source direction are undertaking affairs like design, marketing, financial planning and procurement while the firms located in target direction undertake stocking, dispatching, distribution, after sales service, retailing, education and logistics.

Specialized programs developed by governments ensure the national aims of countries about their economic improvements and competitive strengths significantly. Many countries that perceive design as a basic constituent of cultural and industrial policies up to now have carried out design support programs in indoor and outdoor sectors in order to accelerate growth, increase export and raise the social welfare level. These programs and support models they include have been invigorated by two ways depending on the national socio-economic structures and governments' perception of design process. While some countries perceived and supported design as a factor within innovation system, others manifested support policies that accept design as an independent activity.

The advantages that are added to products and services by design strategy are defined by the Design Study Group constituted by the New Zealand government as follows:

- Development of current solutions or identification and satisfaction of consumer needs;
- Correlation of marketable factors like shape, functionality, usability, new technologies, environmental sustainability and quality and demand creation.

Governments, national economies and design support policies as a result of them have drifted apart from the industrial focus to 'innovation policy' concept after the 2nd World War. Innovation policy can also be defined as the contemporary version of industrial policy, that economies move from production base to being service based.

A truth getting accepted in many countries is the supporting feature of design on economical activities. Design activity that effects both the sales price and the after sales costs and regarded as the centre of innovation process, can be exposed as one of the most effective tools of producing added value on product.[42]

Therefore, many programs are being performed devoted to raise the interaction between design industry and business environment for the aim of increasing the commercial functions of sectors. The determinative features of these programs are defined in the international case study report of Booz et. al., as follows:

- Defining the role of design by evaluating the size, and strong and weak aspects of design industries;
- Providing support in practice for designers and design businesses;
- Constituting the connections between designers, businesses and society;

- Configuring the design awareness;
- Supporting the businesses for understanding and using design better;
- Supporting the effective usage of design in public sector;
- Generating outdoor markets for design services and design products;
- Supporting design education through various levels of education system.[43]

No matter what its content would be, every design policy is designed through individual – social needs and as to constitute a centre to innovation process by internalizing the approach that design activity is an important competitive factor. Accordingly, it would be helpful to introduce the factors that the term ‘design policy’ is in interaction.

Design activity has penetrated into culture and industry policies in many countries as a result of the shift of competition from production to service based economy. They are mainly activated as design support programmes while they differentiate contextually and structurally. Design activity, as the most effective non-price added value factor of industrial policy, has determined the central role of design policy in consequence of the evolution of industrial policy to innovation policy.

7. Conclusions

National level attempts that were initialized worldwide in the second half of the 20th century and turned into ‘science’, ‘technological development’, ‘innovation’ and ‘design’ policies; are carrying on their continuous evolutions for the satisfaction of the constantly changing requirements of societies. The performances of many developed countries having common basic aims of ‘sustainable economical growth’ and ‘social growth’ are determined by their success in mutating their traditional economies into design oriented innovation economies.

Non-price factors are observed to be stucked out as determining factors by the transformation of knowledge into product, as a result of the developments in industry triggering the national service sectors in countries beyond industry. Innovation process has entirely adapted to national policy structures in almost every country that have attained economical and social success, through the aim of increasing the national competition level.

While science and technology can be appraised as consequential inputs of innovation process, R&D can be betrayed as a fundamental activity supporting innovation. Being in close interaction with consumer requirements and having a potential to drastically raise the commercial success prospect, design activity that is more comprehensive than ‘invention’ and ‘innovation’ in this basic constitution, should be illustrated as a genuine and central component and a basic competitive factor.

REFERENCES

- [1] Kavrakoglu, İ., Gedik, S., Balkır, M., Yeni Rekabet Stratejileri ve Türk Sanayisi. İstanbul, TÜSIAD., 2002.
- [2] Elçi, Ş., İnovasyon: Kalkınmanın ve Rekabetin Anahtarı. Ankara, Referans., 2006.
- [3] Cox, G., Cox Review of Creativity in Business: Building on the UK’s Strengths. Report, Norwich, HMSO., 2005.
- [4] NESTA, Total Innovation: Harnessing All Forms of Innovation to Maximise Competitive Advantage. London, NESTA., 2008.
- [5] BIS, The Community Innovation Survey. Report, London, COI., 2007.
- [6] Elçi, Ş., İnovasyon: Kalkınmanın ve Rekabetin Anahtarı. Ankara, Referans., 2006.
- [7] TÜBİTAK, Frascati Kılavuzu Araştırmave Deneyisel Geliştirme Taramaları İçin Önerilen Standart Uygulama. Ankara, TÜBİTAK. 2002.
- [8] Tether, B.S., In the Business of Creativity: An Outline of a Project Investigating, with Evidence from the UK, the Role of Designers & Design Consultancies in Innovation in the ‘Networked Economy’. Centre for Research on Innovation and Competition (CRIC). Copenhagen, DRUID Summer Conference., 2003.
- [9] BIS, The Community Innovation Survey. Report, London, COI., 2007.
- [10] TÜBİTAK, Frascati Kılavuzu Araştırmave Deneyisel Geliştirme Taramaları İçin Önerilen Standart Uygulama. Ankara, TÜBİTAK. 2002.
- [11] TÜBİTAK, Frascati Kılavuzu Araştırmave Deneyisel Geliştirme Taramaları İçin Önerilen Standart Uygulama. Ankara, TÜBİTAK. 2002.
- [12] Er, Ö., Endüstriyel Tasarım, Teknolojik Yenilik, AR-GE: Türkiye’deki Mevcut Teşvik Uygulamalarında Endüstriyel Tasarımın Yeri ve Politika Önerileri. 2001.
- [13] Von Stamm, B., Managing Innovation, Design and Creativity. Chichester, John Wiley and Sons., 2003.
- [14] Tether, B.S., In the Business of Creativity: An Outline of a Project Investigating, with Evidence from the UK, the Role of Designers & Design Consultancies in Innovation in the ‘Networked Economy’. Centre for Research on Innovation and Competition (CRIC). Copenhagen, DRUID Summer Conference., 2003.
- [15] DTI, Creativity, Design and Business Performance. DTI Economics Paper No:15. Report, DTI Pub., 2005.
- [16] Bessant, J., Whyte, J., Neely, A., Management of creativity and design within the firm. Advanced Institute for Management and Imperial College. 2005.
- [17] Er, H. A., Er, Ö., Endüstriyel Tasarım ve Sürdürülebilir Rekabet: Ulusal Tasarım Politikaları İçin Bir Öneri.” Türkiye İktisat Kongresi, İktisadi Sektörlerde Gelişme Stratejileri Tebliğ Metinleri – II 2004 , İzmir, 5-9 Mayıs 2004. Ankara, DPT, 2005. 5, ISBN 975-193716-7 (set)., 2005.

- [18] Er, H. A., Does Design Policy Matter? The Case of Turkey in a Conceptual Framework. World Design Forum 2002: Design Policy and Global Network. South Korea, Seongnam. 2002.
- [19] NESTA, Total Innovation: Harnessing All Forms of Innovation to Maximize Competitive Advantage. London, NESTA., 2008.
- [20] Er, Ö., Endüstriyel Tasarım, Teknolojik Yenilik, AR-GE: Türkiye'deki Mevcut Teşvik Uygulamalarında Endüstriyel Tasarımın Yeri ve Politika Önerileri. 2001.
- [21] Verganti, R., Design-Driven Innovation: Changing the Rules of Competition by Radically Innovating What Things Mean. ISBN 978-1-4221-2482-6. Harvard Business School Corporation., 2009.
- [22] Tether, B.S., The Role of Design In Business Performance. DTI Think Piece. CRIC, University of Manchester., 2005.
- [23] Cox, G., Cox Review of Creativity in Business: Building on the UK's Strengths. Report, Norwich, HMSO., 2005.
- [24] Er, H. A., Er, Ö., Endüstriyel Tasarım ve Sürdürülebilir Rekabet: Ulusal Tasarım Politikaları İçin Bir Öneri." Türkiye İktisat Kongresi, İktisadi Sektörlerde Gelişme Stratejileri Tebliğ Metinleri – II 2004 , İzmir, 5-9 Mayıs 2004. Ankara, DPT, 2005. 5, ISBN 975-193716-7 (set)., 2005.
- [25] Çalgüner, A., The Effects of Technological Changes on Photographic Camera Designs and Their User-Product Relationships. MS Thesis, Ankara, METU., 2002.
- [26] Kavrakoglu, İ., Gedik, S., Balkır, M., Yeni Rekabet Stratejileri ve Türk Sanayisi. İstanbul, TÜSİAD., 2002.
- [27] Gemser, G., Leenders, M.A.A., How integrating industrial design in the development process impacts on company performance. The Journal of Product Innovation Management. 18(1), pp.23-38, 2001.
- [28] Elçi, Ş., İnovasyon: Kalkınmanın ve Rekabetin Anahtarı. Ankara, Referans., 2006.
- [29] Taymaz, E., Small and Medium Size Enterprises in Turkish Manufacturing Industries. Journal of Economic Cooperation. 22, pp.43-72, 2001.
- [30] Taymaz, E., Small and Medium Size Enterprises in Turkish Manufacturing Industries. Journal of Economic Cooperation. 22, pp.43-72, 2001.
- [31] Caracostas, P., Muldur, U., Society, the Endless Frontier: A European Vision of Research and Innovation Policies for the 21st Century. The European Commission, Brussels. 1998.
- [32] IBM, Global Innovation Outlook 2.0, 2005. International Business Machines Corporation. www.ibm.com/gio, 2005.
- [33] Ege, A. A., OECD Ülkelerinde Yenilik Sistemleri ve Türkiye İçin Durum Değerlendirmesi. Report, Ankara, Sosyal Sektörler ve Koordinasyon Genel Müdürlüğü, 2002.
- [34] Freeman, C., The 'National System of Innovation' in historical perspective. Cambridge Journal of Economics. 19, pp. 5-24., 1995.
- [35] Durgut, M., Göker, A., Üçer, A.Ş., Türkiye İçin Teknoloji Öngörü Çalışması Model Önerisi. METU Economy Congress V. Ankara, METU, 2001.
- [36] Pan, T.W., Measuring the Efficiency of National Innovation System. Journal of American Academy of Business. 11(2), pp.176-181, 2007.
- [37] Patel, P., Pavitt, K., "The Nature and Economic Importance of National Innovation Systems." STI Review, 14, pp.9-32, 1994.
- [38] Taymaz, E., Small and Medium Size Enterprises in Turkish Manufacturing Industries. Journal of Economic Cooperation. 22, pp.43-72, 2001.
- [39] Elçi, Ş., İnovasyon: Kalkınmanın ve Rekabetin Anahtarı. Ankara, Referans., 2006.
- [40] Elçi, Ş., İnovasyon: Kalkınmanın ve Rekabetin Anahtarı. Ankara, Referans., 2006.
- [41] Stoneman, P., The Economic Analysis of Technology Policy. Oxford, Clarendon Press. 1987.
- [42] Er, Ö., Endüstriyel Tasarım, Teknolojik Yenilik, AR-GE: Türkiye'deki Mevcut Teşvik Uygulamalarında Endüstriyel Tasarımın Yeri ve Politika Önerileri. 2001.
- [43] Booz, Allen, Hamilton, International Case Studies Report: Developing Victoria's Design Capability. Report, Melbourne, 2003.