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NATIONAL INNOVATION SYSTEM BUILDING IN A DEVELOPING COUNTRY CONTEXT: THE CASE OF TURKEY

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Abstract

Drawing upon the rich theoretical insights on the central status of technological change and innovation in national development, this dissertation investigates policy development processes at the national level and private firm and extra-firm institutional interactions at national, international, and regional levels to gain insights on the national innovation system construction processes in a developing country context, Turkey. Cognizant of the strong emphasis in contemporary literature on crucial role of regional agglomeration processes in stimulating innovation and competitive advantage and the unique context and challenges to accelerating innovation in developing countries, the study utilizes regional and national innovation system frameworks as supplements to each other to investigate the local and non-local networking patterns of firms and institutions within major economic regions. The dissertation research shows that NIS construction process is changing and evolving as shortfalls, failures and unmet needs are identified. The major issues with respect to the applicability of the NIS framework are fostering a basic cultural awareness of the importance of innovation, building a systems perspective among program implementers and establishing meaningful information sharing and collaboration mechanisms across bureaucratic boundaries. At the firm level, the linkages and collaborations are at an early stage of development and exhibit certain problems and frictions. Firms' innovation processes are not contingent upon systemic regional relationships or collaborations and mostly reflect higher national and international influences overriding the advantages rising from proximity to major local actors and institutions. Firms try to access to knowledge irrespective of their collaborators proximity. Therefore, leveraging synergies between innovative actors and knowledge providers, irrespective of space, might serve better for the fuller development of the firms and also the developing national innovation system.

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Chapter 1: Introduction

An Integrated Multi-level Approach to Evaluating Technology and Innovation Policy Design and Implementation in a Developing Country Context

1.1 Overview

The principal research questions explored in this dissertation flow from the classic problem of how developing countries can improve their development performance through the enhancement of their technological and innovative capacities. The basic aim of this dissertation is to draw upon the insights of the national innovation system (NIS) framework to better understand and evaluate efforts to improve technology and innovation outcomes in middle-income developing countries. The NIS framework, rooted in institutional and evolutionary economics, analyzes how technological change and innovation are shaped by complex interrelationships among laws, policies and private and public institutions within a nation state. Because the (NIS) framework has been employed primarily to explain innovation and growth dynamics in advanced market economies, this work will attempt to recast and apply NIS concept to a developing country context by delineating the NIS construction processes in Turkey.

In contemporary economic development literature there is a growing consensus that national technology and innovation performance cannot be understood solely in the context of macro-level forces. Advances in national development are seen to be in part shaped and driven by the ability of dynamic and innovative regional economies to produce globally competitive products and services. Therefore, the construction of a national innovation system through policies and the evolution of private firms and public institutions must consider and encompass local agglomerations that enhance technological improvement and innovation. In this context this dissertation focuses on the three dominant regional economies to explain the dynamic nature of innovation processes in the Turkish case. In the three case study regions, Ankara, Istanbul, and Izmir, I investigate the significance of linkages and networks among manufacturing firms and “extra-firm” institutions universities, public research institutions, government agencies, financial institutions, industrial associations, etc. involved in the emergence and diffusion of new technologies and knowledge. In sum, this dissertation aims to capture the nature of interactions among system stakeholders both at the inter-regional and intra-regional level and identify the main successes and remaining barriers to the fuller development of the national innovation system in Turkey. Before further elaborating on the objective and scope of the dissertation I should state that this dissertation adopts a definition of innovation as “the processes by which firms master and get into practice product design and manufacturing processes that are new to them whether or not they are new to the universe or even to the nation” (Nelson 1992:349).

1.2 Theoretical Context

The status of technological development and innovation have moved the center of international development theory as a result of theoretical advances in economic growth theory and compelling empirical and case study evidence from countries such as Japan, Korea and Ireland that advanced rapidly from low to high income status. Earlier economic growth theories in the neoclassical tradition posited a general tendency toward per capita income convergence as more countries were integrated into the global market economy. While there has been some general trends toward per-capita income convergence, especially with the recent rise of China and India, uneven and highly unequal economic growth trajectories have persisted even as globalization has become a more extensive and powerful force.

The older neoclassical theory did not view technological advance as a central factor in the economic growth process. They viewed technological change as exogenous to the growth process (Solow 1957). The knowledge related to inventions and innovations was viewed as a free public good accessible to all. Knowledge was seen as a byproduct of basic scientific research occurring mostly in public institutions which firms could access free of charge. As such, the conventional theory could not conceive of any durable national or regional advantage from the possession of technological knowledge or innovative capacity. In terms of uneven international development, if technologies and knowledge really did fall like manna from heaven, less developed countries could simply learn to exploit them and converge toward the more advanced economies.

However, post WW-II history suggested that catch up and convergence was not a clear trend and that major frictions could be found in highly uneven endowments of human capital and technical and innovative capacities that appeared to be reproduced over time. This led to the development of a set of new growth theories that viewed technological change as endogenous to the growth process. In Romer's new growth theory, for example, to create new innovations standard labor inputs are not sufficient, human capital must be devoted to the task, and human capital is more productive with a larger stock of knowledge (Romer 1986, 1990). The more knowledge there is, the more productive R&D efforts are—higher human capital produces more knowledge; the greater the stock of human knowledge, the more productive the human capital. In the new growth theories, a process of cumulative causation can take hold whereby new knowledge and human capital lead to still more innovation and human capital accumulation. Therefore, countries not at the innovative frontier might not catch up and leading countries can maintain a durable comparative advantage in technology and know-how. In this context, evidence contradicting the convergence hypothesis in the form of durable leading and lagging nations might be explained by uneven capacities to generate new knowledge and human capital to support innovation and technological progress.

Further theoretical and empirical analyses of uneven technological change and innovation explored the specific processes and institutions that drove technological advance. Schumpeter's disequilibrium theory of profits and economic growth puts innovation and monopoly profits (or technological rents) at the heart of the accumulation process. Hence the structure and relationship of institutions that support innovation becomes a central object of analysis in any account of economic growth. Careful analysis of the innovation process and the institutional support for technological advance, including the role of public sector institutions, has become a crucial component of growth and development studies over the last 40 years. This research has provided strong evidence that nations or regions can maintain or improve their growth prospects by stimulating human capital and R&D complementarities, creating supportive legal frameworks, investing in innovation, and creating institutional supports and incentives to foster innovation in private firms.

In addition, recent work in economic geography and innovation studies argue that knowledge spillovers, from R&D and human capital investment are spatially bounded for a period of time. As Krugman says knowledge travels across hallways easier and more efficiently than across continents (Krugman 1991). This is supported by the idea that technology transfer or innovation spillovers involve the transmission of tacit as well as codified knowledge. Proximity, networks and face-to-face contact increase the efficiency of tacit knowledge transfer. This aspect of classic agglomeration economies put into relief the metropolitan region as a potentially significant unit of analysis in the study of uneven patterns of technological change and regions become important in evaluating national technology policies.

The most recent and systemic attempt to explain uneven national performance in technology development and innovation is the National Innovation Systems (NIS) framework. This framework studies how technological change and innovation is shaped by a complex ensemble of law, policies and institutions that are built up over time and evolve within a nation state. An innovation system, in its broadest terms, can be defined as a system that consist of firms, institutions and organizations, operating together through continuous interactions to produce new and economically valuable knowledge (Lundvall 1992, Lundvall, Johnson, Andersen 2002). Key system components include legal standards affecting property rights, technical standards, education and training institutions, firm and industrial research and development activities, direct public investments in R&D, institutions supporting technology diffusion, government research priorities and institutions and so on. The NIS framework carefully delineates the complex institutional set up in a particular nation, but is especially concerned about how the components interact and evolve over time to foster the accumulation of technological and innovative capacities. The effective running of the system, the art of co-existence of many units and agencies working toward similar objectives, and learning to achieve them, depends in important ways on the ability of governments to design policies that nurture the quality of interactions among institutions. Different national histories, patterns of intergovernmental relations and institutional set ups shape patterns of interaction and cooperation. These differences in turn influence the characteristics of specialization and innovative performance between nations.

The applicability of the NIS framework to lower and middle income countries requires a specific understanding of the status of technological change and innovation given the level of industrial, technical and educational development in a country and a consideration of how state institutions and actors attempt to structure technology and industrial policies to increase the pace and impact of innovative activities. A main advantage of the NIS approach is that it assumes that context matters greatly and national efforts to change technological performance cannot be drawn from a recipe list or "reverse engineered" from experiences in advanced economies. It can be said that the national innovation systems framework is an ex-ante not an ex-post concept in developing countries (Arocena and Sutz, 2000). Layered public and private institutions that make up systems in advanced market systems generally do not exist or exist in very weak or fragmented forms that exhibit limited interaction among public and private sector institutions (Intrakummerd et.al. 2002, Alcorto and Pere 1998, Radosevic 1998, Viotti 2002, Shulin 1999). Meaningful attempts to construct NIS elements and foster knowledge building interactions between the elements necessitate a durable and energetic commitment by governments which are typically reluctant or inexperienced in developing integrated policies. Momentum and coherence in NIS construction is also difficult to sustain because outcomes are uncertain, hard to evaluate, and likely to occur over time horizons much longer than typical political cycles.

However, the unexpected rise of some middle income countries in the 1990s including Taiwan, Israel and Ireland, which were previously not recognized for their capabilities in high-technology industries, highlighted the important role of government technology and industrial policies and support institutions in shaping technological advance and the international competitive positions of these countries. These cases, all of which adopted unique means and approaches in developing their competencies, provided evidence that developing countries have multiple options to follow in establishing more advanced high-technology sectors. These options are shaped by critical decisions on: acquisition of research and development (R&D) skills and competencies and their repercussions on institutions playing leading roles in innovation; R&D financing mechanisms determining the level of resources and scope of R&D activity; state support for leading technology companies and their long-term impact on the established market system; and foreign investors and how they contribute to development of local innovative capabilities (Breznitz, 2005). These success stories of the 1990s, combined with earlier cases rapid development of technological and innovative capacities such as Japan and South Korea, indicated national innovation systems could be constructed and made to "work" through targeted innovation policies linked to national industrial policies. The study of NIS construction in developing countries is relatively limited. In particular, there is very little understanding of specific planning and decision making processes associated with NIS construction and no systematic accounts of the process from perspective of the key actors and institutions directly engaged in technology development and innovation. Moreover, there is very little understanding of the nature, scope and quality of stakeholder interactions that usually define unique characteristics of individual national innovation systems.

1.3 Key Questions and Methods

The basic aim of this dissertation is to draw upon the insights of the NIS framework to better understand and evaluate efforts to improve technology and innovation outcomes in middle income developing countries. This dissertation will investigate specifically how national technology and innovation policies in Turkey have evolved and evaluate recent attempts to structure these policies around the NIS framework. This work will also examine how national technology and industrial policies in Turkey incorporate existing centers of regional industrial and technological development into the construction of the national innovation system. The study utilizes the regional scale to analyze innovation networks among the manufacturing firms and between these firms and regional and national "extra firm" institutions. In particular, I will highlight evidence of emerging interactions, dynamic relationships between firms and other institutions and their geographies during the national innovation system construction process.

It is hoped that this research will make a unique contribution by focusing on specific challenges faced in NIS construction in the specific context of Turkey. In addition, the gaps and successes and failures in developing system components and encouraging interactions between key public and private sector institutions will be evaluated through extensive interviews of those most directly and actively involved: firm managers and R&D personnel, government planning agencies, universities and research institutes, and managers of technology assistance initiatives.

This work will specifically seek to address seven main questions:

1. What is the historic role of the central government in supporting technological development and innovation in Turkey?
2. What level of national and technical and industrial development was achieved by the end of the 1990s under numerous post WWII government technology and innovation planning initiatives?
3. What were the distinct planning, policy and institutional initiatives that characterized the new emphasis on building a NIS system beginning in the late 1990s?
4. What are the major difficulties and problems confronting policy makers in their efforts to build a more effective national innovation system?
5. How strong are intra and inter-regional (including international) networks and relationships among innovative manufacturing firms in Ankara, Izmir and Istanbul?

6. How present and deeply embedded are components of regional innovation systems among innovative manufacturing firms in the main Turkish regions- Ankara, Izmir and Istanbul?

7. How can national innovation policy take better advantage of existing strengths and capacities at the regional level?

This study adopts an integrated multi-level methodological approach to explore the ex-post national innovation system construction processes in a developing country setting. The study critically evaluates regional and national innovation system frameworks advanced in the literature and through international institutions (such as the World Bank and OECD) to investigate their applicability to the national innovation system building process in Turkey. Of central importance here is to understand whether technical and innovation collaborations show a regional or inter-regional character and the implications of these findings for national policy construction.

At the national scale, the role of technology and innovation policy is fundamental (Mytelka and Smith 2002, Sotarauta and Srinivas 2005) since it influences the direction of industrial development. National policy must focus on the business sector since it is the backbone of a national innovation system and any kind of change or transformation requires change and reorientation of private firms (Teubal 2002). In the case of Turkey, national policy determines the strengths of the supporting structure which includes universities, public research institutes, technology centers, business associations and government steering institutions, whose actions directly or indirectly influence the functioning or and strategies of private firms. The specific ways that national policies are being utilized (or not utilized) by firms and how participation with government programs and institutions is influencing the innovative performance of firms, is an important object of empirical investigation in this work. At the regional scale, I will examine empirically the interactive character of innovation networks during the emergence of product and process innovations and determine the importance of links and relationships within the regions compared to those outside the region. The novelty of this research rests in part on explaining a multidimensional issue at different spatial scales in an integrated way. Regions, in this respect might have great explanatory value as agglomeration economies may foster innovations in local firms or industry clusters and hence shape the dynamics taking place at the national level (Isaksen et.al 2001, Muller 2001, Simmie 1998, 2001).

In order to answer the research questions, the study adopts a mixed methodological approach and utilizes case study, in-depth interview and survey methods. To examine the relative importance of national versus regional relationships, two levels of case studies were used to understand spatial considerations of the national innovation system building process in Turkey. Case study research methods are especially valuable in understanding and explaining complex social phenomena through in- depth studies of real-world actors and institutions (Yin 1994).

At the national scale, Turkey emerges as an illuminating case for assessing emerging innovation system features because she is a middle-income developing country with certain innovation system characteristics, which are neither fully developed nor especially weak or fragile. The long science and technology policy and plan making history of the country opens up a number of opportunities to understand the interplay between structural impediments to more advanced development and institutional learning formed out of prior successes and failures. In addition, Turkey is a centralized nation state where all regions are subject to the same regulatory, institutional and macroeconomic rules and processes. The country, therefore, offers an informative context to assess the significance of more spontaneous regional characteristics that may emerge from the interplay between market forces and unique local business cultures or institutional arrangements.

At the regional scale, Istanbul, Izmir and Ankara metro areas appeared as the most significant cases to explore the main research questions as they are the three biggest cities in the country and host the vast majority of prominent public and private institutions central to the national innovation system. It should be noted that this study intends to use the regional innovation system concept as an instrument to evaluate the status of NIS construction in Turkey. In this respect, the cases at the regional level are not selected because they represent some distinct types of relatively autonomous regional innovation systems as exemplified in the literature. These regions are selected because they are inherently part of a centralized administrative structure yet informative enough (in terms of industrial variety, intensity of knowledge and technology, institutionalization, etc) to explain national dynamics from the bottom.

The qualitative approach in the study was needed to examine system building processes through in-depth questioning of policy makers, research scientists, industry and trade organization officials, technology development incubator officials, etc. who were active while new policies were forming on NIS construction in Turkey. Further, a qualitative approach was required to understand the unique and detailed characteristics of regions that stimulate interactions and innovations. Firms as the major players of investigation were the subject of extensive in-person interviews to extract the kind of specific and nuanced knowledge essential to understand their innovation efforts and their relationships with other institutions and actors. This approach provided much more context rich and specific understanding through repeat and follow-up questioning than would be yielded by structured postal surveys or other large sample survey techniques. On the other hand the relatively large number of face-to face interviews/surveys (83) that were conducted allowed a deeper understanding of the characteristics and patterns of innovative activities of large number of firms and the importance of interactions with other actors in the system.

The adopted mixed methodology based research design strategy offered unique insights into key research questions and followed the four subsequent steps. First of all, in order to evaluate recent attempts to structure technology and innovation policies around the NIS framework, the research examines historic and contemporary government planning documents on innovation and technology policies. The policy documents and plans were collected and reviewed based on their focus upon technology and innovation based capacity and capability development. This step also included interviews with key participants in recent innovation planning and policy including policy makers and analysts in the State Planning Organization (DPT), The Scientific and Technical Research Council of Turkey (TUBITAK), the Technology Development Foundation of Turkey (TTGV), the Small and Medium Industry Development Organization (KOSGEB), the Under-Secretariat of Foreign Trade (DTM), the Ministry of Industry and Trade (STB), and KOSGEB-TEKMER (KOSGEB Technology Development Centers).

The second step involved the study of current documentation on industry structure, industry strengths, employment, exports and any data relevant to competitiveness and innovativeness of industries and the study regions. Location Quotient and Shift-Share Analysis were conducted to understand the basic industrial compositions and dynamics of the regions. This stage also included identification of the firms engaged in technology development that would be included in empirical study in three major industrial regions of Turkey.

The third step was identification and study of public and private development, research and technology organizations through in-depth interviews with leaders in universities, research institutes, technology transfer agencies and business associations that contribute to technology development and innovation in Ankara, Izmir and Istanbul. And the final step was in-depth examination of a randomly selected sample of innovative firms in the manufacturing industry in three major industrial regions in Turkey that received government R&D support.

The integrated multilevel research enabled the study of NIS construction processes through the eyes of policy makers, bureaucrats, analysts, and researchers; and the R&D personnel and firm mangers in Turkish companies. The broad scope of the NIS research in a developing country context is managed through the introduction of regional scale which provided important insights with respect to the importance of regional processes to the direction and performance of the NIS construction process. Following these respective elements, the dissertation is organized as follows.

This introductory chapter is followed by a theory oriented literature review chapter. This review delineates theories concerning the significance of technology and innovation in national growth and development from several theoretical traditions in political economy and economics that the dissertation draws upon, including evolutionary economics, state developmental theories, and national and regional innovation system frameworks. This chapter gives special attention to the role of state and public policies in the economic growth processes of emerging and/or developing nations and to the role of regional agglomerations and networks in national developmental efforts. It discusses the gaps in the NIS literature in developing countries and presents RIS as a practical means to bring the significant role of regional agglomerations into the NIS discussion in developing country contexts.

The third chapter introduces the integrated multi-level methodological approach to analyze innovation system building processes in Turkey by highlighting the objective of the research and the fieldwork chronology and experience. The research methods and instruments section covers a brief profile of the case study regions, data sources including identification of supporting institutions that form the NIS framework in Turkey and the interviewees, and identification of firms to study: the process of sample selection and survey implementation.

The fourth chapter provides a historical overview of the industry, technology and innovation policies in Turkey, and lays out developmental histories of industry, science, technology, and innovation policies in Turkey to frame and interpret current innovation policies in a historical context. The history of modern manufacturing development starts with the Ottoman period and continues with the early republican period. This was followed in the Post WW-II period by a period broadly emphasizing import substitution based development (1960-1980), followed by export oriented industrialization (1980 to the present) policies. I then review more contemporary science, technology and innovation policies and touch upon the problems associated with the adoption and implementation of plans and policies given long term political and institutional influences.

Chapter 5, evaluating the NIS construction process, draws upon the previous chapter and evaluates the roles, duties and interactions of public institutions and policy makers with other actors during the recent national innovation system building process in Turkey. The chapter examines the applicability of NIS in Turkey and discusses the strengths and weaknesses of Turkish NIS.

The sixth chapter focuses upon the specific technology development and networking characteristics of Turkish manufacturing firms and evaluates innovation behaviors of manufacturing firms in all three regions in aggregated terms. This chapter adopts an integrated approach and highlights innovation practices, characteristics, significance of external links and barriers to innovation in all three regions.

Chapter 7, the role of regional agglomerations and networks in technology development investigates industrial specialization and change, local elements of NIS and embeddedness of the firms in Ankara, Izmir and Istanbul. This chapter evaluates the importance of regional agglomerations and presence or absence of local linkages and also significance of existing linkages with respect to new product and technology development.

The concluding chapter brings together main findings from the chapters 5, 6, and 7 and addresses the successes as well major difficulties and problems confronting policy makers in their efforts to accomplish to build a more effective national innovation system.

Chapter 2: Theoretical Framework

The literature and evidence on the status of innovation and technological change in developing countries is limited in a number of ways. First, there are a relatively small number of studies that characterize and analyze the role of innovation in specific cases of national development in middle or low-income countries. Second, much of the analysis of technological change in developing countries attempts to directly apply frameworks derived from studies of innovation processes in advanced market economies. In this dissertation I attempt to reach beyond prior studies to isolate insights from the broader literature that apply more usefully to the developing country context and test these insights in an in-depth case study of firms and public and private support institutions related to the innovation process in a middle-income country.

In this chapter I reference several theoretical traditions in political economy and economics including neo-classical growth theories, evolutionary growth frameworks, technology gap theory, state developmental theories, and national and regional innovation system frameworks. These theories provide context for the main themes of this work including the impacts of state policies on technology absorption, development and diffusion across countries. The specific case of Turkey as an example of technological and institutional development in a newer industrializing country can also be better understood and evaluated in reference to these major theoretical strands. The first key challenge in this work is to understand how national innovation system (NIS) framework that has been developed to explain innovation and growth dynamics in advanced market economies can be recast and applied to the NIS construction process in a developing country context. The second aim is to understand how regional agglomeration economies, especially knowledge spillovers might come into play in the industrial and technological development of emerging nations. In order to better comprehend these issues, it is necessary to borrow insights from several different theories. Late development and developmental state theories deserve special attention as they are more directly relevant to role of the state and public policies in economic growth processes of emerging and/or later industrializing countries.

2.1 Traditional and Contemporary Neoclassical Growth Theories

In the conventional neoclassical economic growth theory developed in the 1950s, firms are viewed as atomistic entities operating to achieve profit maximization objectives. In this static view, new knowledge and technology are created "outside" of the economic sphere as public goods and are viewed as basically exogenous to the process of economic growth per se. Firms have full and perfect information on available technologies and they select the optimizing technologies given factor prices and demands for their goods and services. In other words, all firms are on equal footing in gaining access to technology to compete on the basis of prices of undifferentiated products. The basic proposition that technology is a universal public good in a macro system that tends toward equilibrium sets up the conditions of a tendency toward international convergence in national per-capita income.

In the earlier neo-classical models a long-run equilibrium growth is determined by the growth in the labor force (or population), the growth rate of the capital stock and an exogenous rate of technological improvement. In long term full employment equilibrium, with the GDP and the capital stock growing at the rate of labor force growth, growth in GDP per capita becomes contingent on the exogenous rate of technological improvement (Fagerberg 1995). As an explanatory factor of long-run economic growth, Solow [1](1956)

[1] Solow's (1956) model: $Y = A \quad K^{\alpha} L^{1-\alpha}$ (where Y is output, A is technology, K is capital and L is labor)

incorporated technology into the neo-classical growth model where technology is treated as an autonomous growth factor that is exogenous and available to all firms and countries.

Solow (1957) conducted a seminal empirical study to account for growth in the US economy where he found that only a small portion of the growth in US output per worker over the 1909-1949 period could be attributed to increased capital intensity. The remaining productivity growth that could not be attributed to increases in capital intensity was identified by Solow as a "residual" component reflecting general technical change (Scherer 1999:24). Solow's famous "residual" could include many things, but it was believed that technical change constituted the major part. Later, following Solow's work, many growth accounting studies were conducted to measure this "residual" factor and what share of economic growth could be attributed to advances in technology. (Madison 1987). In these earlier models technology was identified as a crucial dimension of economic growth in the neoclassical production function, yet technological change was exogenous and typically "embodied" in the capital or labor factors in conventional growth accounting.

The implications of this traditional theory for uneven international growth were important in that a general pattern of per capita income convergence was consistent with the general equilibrium premises of the model. Output per capita increases in the long run because of exogenous technological progress and convergence happens along the transition course as lower income countries with abundant labor get higher returns from capital investment. Countries below their steady state positions will, hence, grow faster than higher income countries closer to their steady state positions due to diminishing returns to capital investments or inputs. In other words, for countries with the same steady positions including same savings rate, population growth rate, government policy and etc., poorer economies grow faster in GDP per capita than the richer ones (Barro and Sala-i Martin 1997:1, Sala-i Martin 1996).

The older neoclassical growth theory does not entail any explicit theory of innovation per se because it does not provide any explanation on how or why technical change occurs in an economy. Significant income and growth differences across countries were not easy to explain based primarily on different rates of capital investment. These gaps led to increased efforts to endogenize technological progress in more meaningful ways in subsequent growth theories. Most notable was the emergence of the new neoclassical growth theory, pioneered in the work of Romer (1986, 1990) and Lucas (1988). These contributions criticized the exogenous technological change assumptions of the older growth theory by abandoning the blanket assumptions of perfect competition and "cost free" access to technology by all firms regardless of location. Instead, they argued that knowledge is endogenous and that economic growth results from increasing returns associated with knowledge, which is, unlike other economic goods, is non-rival yet partially exclusive. The more knowledge is accumulated, the more productive human capital investment becomes. Hence, the enhancement of human capital and accumulation of knowledge serve as the primary engine of long-run economic growth in these newer theories.

The new growth models also try to endogenize technological change by accentuating the public-private nature of the innovation process (Romer 1990, Grossman and Helpmen 1991, Aghion and Howitt 1992). Technology and knowledge can be retained within firms (excluding third parties) and returns from successful innovation can be used to compensate for the expenditures made during the process of technology generation. Rival firms can be excluded from new knowledge and technology for some period of time through patents or secrecy. This leads to a situation of imperfect competition and possibly above normal returns that compensate for private R&D or other knowledge investments. However, there is also non-excludable part that cannot be appropriated due to knowledge spillovers. Some technology and specific skills spill over from the innovative firm and generates positive external effects on the product, service and process technologies of other firms. These positive externalities contribute to increasing returns in the overall output of goods and services (Ruttan 2001). At the same time, these technological rents and spillovers dissipate over time as other firms catch up with original innovators.

The new growth theory undercuts the strong convergence hypothesis of the older standard theory by questioning the assumptions of decreasing returns to capital inputs, perfect competition and exogenous technological change. It replaces the diminishing returns to capital assumption with increasing social returns to human capital assumption. In the new growth theory, knowledge spillovers can amplify initial differences among countries through cumulative causation processes. Cumulative causation suggests, that "if a region gains some initial advantage, new growth and multiplier effects will tend to concentrate in the already expanding region, rather than in other regions" (Malecki 1997:48). If cumulative causation emerges, growth becomes self-reinforcing as endogenous forces tend to increase productivity by attracting still more new knowledge and higher returns to human capital. Human capital also affects this process by flowing to regions where there is already larger stocks of knowledge and skilled labor. Advanced countries, in this respect, can sustain durable advantages relative to developing countries. Given that there are lower levels of human capital accumulation and less efficient access to local or global pools of knowledge in developing countries, these countries might not catch-up in the long run. Thus, in the new growth theory, per capita income differences across countries can persist in the long run and are not inherently subject to general equilibrium tendencies.

2.2 Institutional and Evolutionary Growth Theories

In both the older and more contemporary neoclassical growth models the more tangible and specific contours of knowledge generation and innovation processes both within and external to the firm are poorly specified. The neoclassical tradition offers only abstract answers to the "why" and the "how" questions of technological change and economic growth. In contrast, Schumpeter provides a more specific and historically grounded account of the growth-innovation relationship based upon the central role of innovation in private market competition. Schumpeter viewed innovation as a primary determinant of growth and economic growth as fundamentally rooted in a disequilibrium process. Models that posit convergence to a steady state growth path cannot explain growth in capitalist market economies since it is an inherently dynamic process with sharp periods of disequilibrium. For Schumpeter, growth processes can never be smooth or tend toward some steady state equilibrium because capitalism's dynamic force comes from innovations[2] that enterprises create in their ongoing attempts to maximize profitability (Schumpeter 1942:83).

Innovations generate 'entrepreneurial profits' through decreased production costs, new product introductions, and new market openings. Instead of fighting to minimize costs given stable factor costs and price taking on competitive markets, firms compete for profits that come from new or distinct products and services. New products or ways of producing and marketing existing products provide innovating firms with "monopoly

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[2] Innovations in Schumpeter are not necessarily path breaking, radical or 'new to the world' technological changes. They may be new or improved products or processes of production, new sources of inputs supply, new markets for old products and new forms of industrial organization.

profits or rents" over a specific period of time since competitors cannot replicate the innovation in the short-term. The intense competition for 'entrepreneurial profits' is a 'process of industrial mutation' that comes within the economic structure and thereby changes the structure permanently. Firms' incessant search for innovations threatens the existence of other firms that are unable to innovate and in a process famously labeled as 'creative destruction' (Schumpeter 1942:83). Schumpeter's disequilibrium theory of profits and growth puts innovation and monopoly profits (or technological rents) at the heart of the economic growth process. Hence, the structure and relationships of both private firms and public institutions that support innovation is a central object of analysis in any deeper account of economic growth.

Following Schumpeter in placing innovation at the center of the growth process, evolutionary economists perceive innovations as outcomes of qualitative changes in history, persistently driven by the diverse capabilities of firms, governments and institutions (Nelson and Winter 1982, Dosi and Soete 1988). This strand of thought stresses two important issues regarding the nature of innovation. First, the innovative capabilities of firms depend on active searching and learning processes. Searching and learning activities generate real costs for private firms and innovative capabilities are difficult to obtain and are unevenly scattered across firms and countries. Second, innovations are complex, non-linear social processes resulting from formal and informal networks and relationships among firms and other public and private institutions.

Evolutionary economics explains different national performance and patterns in international trade by emphasizing uneven capacities to generate and adopt new knowledge and technologies. Uneven capacities can be associated with a wide range of skill differences and differences in institutional support required for adoption, utilization, imitation and creation of technology (Rosenberg 1982, Dosi and Soete 1988:418, Juma and Clark 2002). In contrast to the assumptions of the conventional growth theory, firms in developing countries operate with a high degree of imperfect knowledge regarding technological opportunities. Finding technologies and their efficient use is a difficult and costly process since it involves developing new skills to master codified and especially tacit elements in new technologies (Lall 1999). Adoption and modification of foreign technologies to local needs also requires a certain level of know-how and technological skills because technologies are typically first developed to serve users and customers in high income countries. Therefore, the earlier less innovative firms understand and prioritize active searching and learning processes with respect to developing their capabilities, the better it will be for their long term economic competitiveness. At the macro level, support systems, incentives and regulatory frameworks that stimulate more active searching and learning by indigenous firms may affect the pace of technological advance and enhance national growth prospects over time.

Hence, a comprehensive explanation of economic growth entails a deeper understanding of both economic and non-economic factors shaping innovation processes. In evolutionary economics, technological change results from conscious and active policy efforts addressing skill building and organizational restructuring at the intra and inter-firm levels. As more firms and institutions become involved in complex learning processes, knowledge flows become more intense and firms can gain more from networking to learn and to innovate. Innovation and growth thus become outcomes of certain socio-cultural contexts shaped by complex interactions among different actors in the system (Nelson and Winter 1982, Dosi and Soete 1988, Malecki 1997).

Evolutionary economics leaves open the possibility for developing countries to catch up with more advanced economies, but catch-up is conditional on specific characteristics and factors. This theoretical tradition does not accept a general process of convergence or divergence since it is not based on steady state, general equilibrium assumptions of neo-classical growth theory and sees growth as a dynamic process stimulated by innovations and institutions. Therefore, in a constantly changing environment, convergence may takes place at different rates in different countries with different institutional settings (Verspagen 1993).

Evolutionary economics also rejects neo-classical growth theory's assumptions about technology as a pure public good. In the evolutionary perspective, less developed countries suffer from existing technology gaps and low capacities to absorb new technology and knowledge. However, poorer countries may advance through diffusion and adoption of foreign technologies if factors favoring these processes develop and accumulate overtime in specific cases (Fagerberg 1994). In this way, evolutionary economics departs from technology gap (Posner 1961) and product cycle theories (Vernon 1966) by emphasizing the possibility of the durable accumulation of resources and development of institutions and practices that foster innovations.

In technology gap and product cycle theories, advanced countries benefit from advantages of continuous product and process innovations leading to divergence in technology levels across countries. Developing countries, on the other hand, work towards diminishing existing technology gaps through successful imitation. Drawing upon Schumpeter's concept of the innovating firm but apply it to national level processes, technology gap theory argues that new innovative products and processes bestow a temporary monopoly advantage to innovating countries. However, through time, advanced countries lose their advantageous positions due to international technology transfers. In order to maintain advantages of the "technology gap" and their relative positions in the international economic order, innovating countries continue to invest in R&D and other support activities to sustain their advantages.

The product cycle theory offers a similar insight only with more emphasis on the specific nature of the technological evolution of industrial products. The model posits a typical pattern of a product's development from the beginning to the end of its lifecycle. Among the four main phases identified in the product life-cycle model, the first phase is the "innovation phase" in which technologies emerge and change rapidly. Here, new disruptive ideas and technologies are introduced and they are typically concentrated in the hands of firms in a few advanced market economies. Firms in this phase are very much dependent on highly skilled research scientists, engineers and producer service providers for idea generation and development and improvement of new technologies. The second phase is the "growth phase" in which larger scale production for a mass market emerges but product and process technologies are still changing and evolving rapidly. The third phase is the "mature phase" where technologies are mostly stable and there is limited room for process or further product innovation. And, the fourth phase is the "decline phase" where technologies are becoming standardized and being replaced with new innovations (Malecki 1997:63). In the product cycle theory, as product and services mature, standardization prevails and this allows the shift of basic production activities from advanced to developing countries. As developing countries master large scale production and/or imitation, they hold a comparative advantage over advanced countries due to their lower wage rates and investment in later vintage production facilities. Advanced countries capture more value-added and higher profit rates in the innovation and growth phases; exporting their products in these phases and then importing them back in the decline phases when production is standardized and the technology is ageing (Freeman and Soete 1997).

Evolutionary economics appreciates the insights of the technology gap and product cycle models, but criticizes their inadequate and limited treatment of more complex innovation processes. In evolutionary perspectives, innovation necessitates accumulation of technologies and supporting structures over time. International technology transfers thus do not take place as easily or in the consistent patterns indicated in the product cycle and technology gap models. In the evolutionary framework, convergence among developing and advanced countries is a possibility, but it is a long and uneven process requiring conscious and constant institution and capacity building efforts on the part of developing countries.

2.3 The Role of the State and Government Polices in Growth and Development

Despite the considerable advances in understanding the role of innovation in uneven growth provided by newer intuitionalist and evolutionary approaches, the specific role of the state and public sector institutions is not systematically explored. The crucial role of government as a potentially leading actor in the growth and development process was first emphasized in the late development paradigm based on the works of Alexander Gerschenkron (1962, 1968, and 1970).

Gerschenkron argues that although backward countries on their path to industrialization do imitate more advanced countries in certain respects, they differ fundamentally from advanced countries "by the very virtue of their backwardness" (1962:6-7). Conditions that limit industrial development, such as the scarcity of capital, competent and disciplined workers and entrepreneurial talent, shape in different ways the speed of development and the productive and organizational structures of emerging industries. So, even though industrial processes that are similar to the ones in advanced countries are launched at in backward countries, their effects are considerably different since backward countries have their own peculiar institutional characteristics that lead to unique patterns and outcomes.

Gerschenkron points to the existence of two major differences among various countries: (1) their degree of backwardness and (2) the vision and ideology of backward states that stresses the importance of competition with the forerunners with respect to technology development and industrialization. Within this framework, Gerschenkron contends that the more backward an economy in the beginning of its industrialization in comparison to other advanced countries, the greater will be the "discontinuity" from its previous economic experiences and hence the greater will be the potential pace of overall industrial growth. As long as states have a strong vision for industrialization, they will emphasize the development of industries making large scale, capital intensive goods whose production techniques can be imported from more advanced countries.

In Gerschenkron's theory of late-comer advantages, backward countries gain from entering already established product markets where they don't need to face the uncertainties and risks of opening new markets. The needs of the global markets for manufactures goods have been delineated by pioneer firms. They also have access to the latest manufacturing technologies, which have been developed through expensive research and development investments by pioneering countries, at much lower costs. Late-comers hence start with large scale "state of the art" manufacturing facilities that benefit from scale economies while pioneer competitors struggle through earlier phases of smaller pilot plant production and poorer process technology. It should also be noted that Gerschenkron ties these late-comer advantages with the advancements in state planning and financial capabilities of backward countries. The existence and guidance of a capable bureaucracy is essential in his view in order to convince financiers to invest in large scale plants and newer technologies. New technologies are out there and easily accessible, as long as these two institutional capabilities are developed, improved and coordinated.

Gerschenkron's theory of late development identifies the crucial role of the state in the development of new institutions but does not recognize the importance of more complex processes of building technological capacities and skills on growth prospects in less developed countries. In Gerschenkron's thesis, the central role of the state is to either directly stimulate production in sectors where investment needs are high or act as a financial creditor in the development of these sectors. Gerschenkron's theory was important because it laid the basis for developmental state theories which tried to shed light on the tremendous growth of Japan after the Second World War (Johnson 1982, Freeman 1987, Anchordoguy 1989) and newly industrializing Asian economies such as South Korea and Taiwan over the past thirty years (Amsden 1989, Wade 1990, Haggard 1990, Pack 1993, Park 2000, Amsden 2001).

Starting with the analysis of Japan, developmental state theories emphasized the role of government in targeting, supporting, and mobilizing finance and investment for new industries. To overcome technological barriers that developing countries face on their path to industrialization, states in a national effort, strategically design and implement long-term development plans by establishing specific development agencies such as MITI (Ministry of International Trade and Industry) in Japan, EPB (Economic Planning Board) in South Korea or CEPD (Council on Economic Planning and Development) and ITRI (Industrial Technology Research Institute) in Taiwan.

MITI's role in Japan's remarkable growth did not only come from a capable bureaucracy designing policies that favor export oriented catching-up strategies, but also from its assigned status which held it responsible for the selection of strategic sectors and technologies. MITI, assumed the role of the "pilot agency" of a state-led development effort that actively intervened and supported the growth of conglomerates that could compete in selected strategic industries (Johnson 1982). The underlying driver of industrial development was a strong, unitary state supporting and mobilizing finance for large investments in the latest manufacturing technologies that were initially designed elsewhere. The Japanese model of technology adoption and product development focused on adoption of the latest process technology to produce products introduced by more advanced counties, followed by continual improvements in both product and process technologies over time.

Taking Japan as a model, Korea also established a “super agency”, EPB that had the power to shape economic policy and the industrial transformation of the country. By meritocratically recruiting the most educated and talented specialists, EPB established a bureaucratic structure that could confront the incongruity of a capital scarce environment with ambitious industrial transformation goals. It supported the emergence and growth of large conglomerates (chaebols) and aggressively “orchestrated their activities” up until they secured significant international market positions among selected industries (Wade 1990: 320, Evans 1995).

Similarly, though with somewhat lighter state direction, Taiwan used a government led approach in its development efforts. The CEPD was not a pilot executive agency as in other cases, but it held powers resembling to MITI’s in most respects. Taiwan established another agency to fulfill objectives in technological arena. She set up the ITRI to build up new capabilities in new technologies with an objective to close the existing technological gaps with advanced countries. In this respect, the state used ITRI as a medium to acquire new technologies from abroad to co-develop these technologies with private firms, to recruit talented workers living overseas, and to directly fund projects to transfer new technologies to other firms (Matthews and Cho 2000, Matthews 2002).

As these developmental efforts transformed these nations from economically backward to higher income countries over relatively short periods of time, scholars turned their attention to the "east Asian model" to better understand how did they it and what lessons could be transferred to other developing countries (Evans 1995, Kim and Nelson 2000, Chibber 2002). The developmental states shared some common attributes in their state-led development efforts. First of all, they all broadly followed the Gerschenkronian model of development by creating targeted, export-oriented industrial systems based on technology transfer from leading nations. Second, they established specific state institutions empowered with certain authority and regulatory powers to formulate long-term industrial plans. And third, based on these plans, they supported growth of large conglomerates and mobilized finance for investment that allows select firms to compete with each other and with international firms to succeed in targeted sectors (Bretnitz 2005). However, as technology and R&D intensive industries became more important in sustaining competitiveness of countries, the traditional Gerschenkronian model of development became less compelling. These East Asian countries faced new challenges as they attempted to move into areas where products and especially services were less well defined and stable, markets were changing more rapidly, and where advanced countries were less willing to transfer the latest available technologies.

As the pace of innovation increases and the life span of new products decreases, leading companies became more protective of new knowledge embedded in their products. Reverse engineering and incremental innovation lost their potency and it became harder to develop competitive products with lower income countries such as China and India aggressively moving into more mature market. In addition, tracking the latest technological developments and rapidly employing them in new industrial strategies went beyond the managerial capabilities of state development agencies. Central state agencies, pressured by the rapid change of technologies and competition from other later developing countries, started to gradually delegate their roles and responsibilities to developmental agencies and to give private market developments more influence instead of retaining lead positions in development of new industries (Bretznitz 2005, Evans 1995, O'Rian 2000, O'Rian 2004). Instead of being organized around a centralized state structure, national governments have established numerous developmental agencies in different policy domains (technology development and transfer, capital access, labor training, etc.) that are flexible enough to deal with the requirements of complex technological systems in different sectors. These agencies are equipped with skills that understand specific needs of industries and constantly redesign policies based on new developments (ORian 2000, 2004). Yet even with this new approach, labeled as the "flexible developmental state" or "developmental networked state", many developing countries in the 90s were unsuccessful at assessing the changing global circumstances and reorganizing themselves quickly enough to cope with the changing needs of their targeted industries and powerful new competitors.

Both late development and developmental state theories emphasize an essential role for national governments in the growth and development of new industries and hence technologies. Although changing global markets and production networks have altered the institutional structures needed to successfully develop or support new industries, developmental states either as initiators or as supporting actors continue to influence the overall growth trajectories of their countries. Unfortunately, different developmental state models are not comprehensive enough to delineate various institutional factors and specific linkages and relationships facilitating development of new industries. Systems of innovation theories, in this respect, fill in gaps and provide a more useful framework to study different institutional models that influence progress of existing and growing industries in both developing and advanced countries.

2.4 The National Innovation System Framework: Policies, Institutions, Interactions and Innovations

The innovation systems approach has been widely used to explain the interactions among multiple institutions and actors that generate and utilize technologies. The concept of national innovation systems (NIS) was introduced in the late 1980s based upon key premises of evolutionary economics (Freeman 1987, Dosi et. al 1988) and further elaborated in the 1990s (Lundvall 1992, Nelson 1993, Edquist 1997). Freeman defines national innovation systems as: "…the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies" (Freeman 1987:1). Among the first to use the concept, he emphasizes the importance of government support in terms of setting a vision for long-term economic development and commercialization of advanced technologies.

Governments play an essential role in any NIS because of the intrinsic nature of innovation and R&D processes. With respect to private sector R&D, market failure occurs because of externalities that are not appropriately valued in private markets. Firms which invest in new technologies cannot internalize all of the returns from their investment because some knowledge and productivity gains benefit other firms or end users. Spillover effects can take numerous forms including the ability of competitors to reverse engineer or copy designs, the mobility of skilled workers who transfer knowledge and skills to new working environments, or communication of new knowledge through more informal channels. As the firms bearing costs of innovation do not capture all the benefits, they under invest in research and development. Because social returns from investment in innovation significantly exceed private returns, sub-optimal private R&D

investments justify government investment and coordination in new technology development activities.

Lundvall further (1992) elaborated the concept and proposed both a broad and a narrow definition of NIS. Broad and narrow definitions of NIS mostly differ based on the scope of actors and domains considered in the analysis of innovation activities. While the narrow definition takes into account only the search for new inventions and innovations or “organizations and institutions involved in searching and exploring such as R&D departments, technological institutes and universities”, the broad definition includes “all parts and aspects of the economic structure and the institutional set up affecting learning, …searching and exploring [such as] the production system, the marketing system and the system of finance…in which learning takes place”. For Lundvall, learning is embedded in everyday experiences of the actors in the system and takes place in every part of the economy (Lundvall 1992:2). Actors in the system including governments, firms, public and private research institutions, universities, customers and suppliers have specific and important relationships among themselves. These multiple domains and actors influence the creation and diffusion of new technologies in industrial systems.

Dynamic relationships among the actors, first of all, influence the production and technology absorption capabilities of firms. By immersing themselves in these multiple relationships, firms learn over time the complex capacities to develop new products and services or invest in new process technologies to expand their product range (Cohen and Levinthal 1989, Carlsson et. al. 2002). Second, private firms as the most dynamic agents in end markets for products and services, get crucial feedback from their customers to improve their outputs and enhance the profitability of their activities. And third, financing institutions both public and private influence firms' behavior to innovate through their decisions to allocate capital to specific R&D activities[3].

Lundvall's broad definition of a NIS attempts to cover all the factors involved in the enterprise of innovation, but it is criticized for its vagueness and lack of specificity (Edquist 1997, Miettinen 2002). Some scholars try to synthesize the broad and narrow definitions to establish conceptual clarity in this newly emerging area of study. For instance, Niosi et. al. (1994) define NIS as a "...system of interacting private and public firms (both large and small), universities and government agencies aiming at the production of science and technology within national borders". According to them, "interaction among these units may involve technical, commercial, legal, social and financial in as much as the goal of the interaction is the development, protection, financing or regulation of new science and technology". Likewise, Radosevic (1998:85) defines systems of innovations as "a coherent configuration of firms, related institutions and organizations that are involved in the generation and utilization of new technologies

[3] Depending on the location of activities, whether they are conducted in private firms or public research institutions or universities, different national financing modes affect the scale and scope of R&D activities. The more financial resources are allocated to higher risk innovative product development activities, the more experience and competence grows among both investors and the private enterprises that acquire capital (Bonte 2004). Private financing is different than public financing, as it looks for high private returns to compensate for high-risk investment. The investors, venture capitalists or other high-risk financiers, are heavily involved in innovative projects and directly influence the capabilities of firms, their business models and their interactions with other producers either in local or global production networks. Public financing and support to private R&D, on the other hand, serves greater objectives such as the advancement of basic science and greater generation of knowledge or innovation related to national missions (defense, public health, national transport, etc). Either targeted (e.g. specific R&D projects mostly in selected sectors) or untargeted (e.g. tax abatements, R&D credits, R&D personnel subsidies) public support intends to increase private firms' general interest to R&D activities. It may have a direct impact on the productivity of supported firms or an indirect impact via generating new knowledge or new technologies with more general applications. Governments may prefer funding projects that have higher social than private rates of return, but measuring the gap is not an easy process (Mansfield et.al. 1977, Jaffe 1989). In any case, both private and public financing generates conditions promoting dynamic learning processes that are broadly simulative for technological development and economic growth.

based on common technological regimes and shaped through mechanisms of market and pre-market selection".

Different definitions of the concept emphasize the "system" dimension stressing the interactions among institutions and actors rather than linear model of innovation beginning with publicly supported basic research and ending with a specific firm introducing and new product or process. The actors involved in different systems may vary, but the quality and value of interactions and within networks of institutions are seen as central in enhancing innovation performance. Nation states, in this respect, tend to generate distinct frameworks as the dynamic relationships among the actors involved in different cultures and systems may change according to specific histories and national industrial and technology policies that influence not only the inter-institutional learning processes but also the scale and scope of R&D activities.

Early studies of NIS mostly examined the characteristics of national technology and innovation policies and institutional differences between advanced countries (Freeman 1987, Nelson 1993). These studies analyze economic performances of specific countries through their technological and institutional capabilities, such as R&D systems, as in the case of Nelson (1993). However, comparative analysis of various national innovation systems presents serious challenges due to unique histories and institutional roles and traditions, even though each country case presents very valuable in-depth information about the formation of policies and development of institutions that foster innovation. A number of more recent studies have focused on measuring the strengths and systemic comparisons of different national innovation systems to better identify elements and characteristics that might explain differences in innovation outcomes.

Furman et.al (2002), for instance, measured the national innovative capacities of 17 highly industrialized countries by analyzing the linkages between the strength of a nation's common innovation infrastructures and the environment for innovation in specific industrial clusters[4]. Nasierowski and Arcelus (1999) developed a NIS model through the identification of specific elements and their interrelationships in each individual national system. Chang and Shih (2003) use national R&D expenditures, R&D performance, technology policy, human capital development, technology transfer and the climate for entrepreneurial behavior as variables to specify the importance of structural differences between innovation systems of China and Taiwan. Although these studies on national innovation systems diverge in terms of questions addressed, methods and their level of analysis, aggregate indicators that are used to measure robustness of systems such as GDP per capita, patents, R&D expenditure, number of scientists and engineers, and quantity and quality of scientific publications tend to be common in many studies. These variables are useful for comparative purposes but they are limited in terms of illuminating the interactive dimensions of learning and collaboration between elements and institutions that comprise the NIS. Also, these variables are more meaningful and consistent for studies of advanced countries because of the high quality of existing data and their representation of higher levels of innovative performance. However, using similar measures in studies on developing countries is problematic as most of these measures are not well constructed in these countries. In addition these common aggregate indicators often miss the dynamics of more incremental innovation and "learning" processes because new patents and path breaking product innovations are not common outside higher income OECD countries.

The early studies on national innovation systems have shifted the attention of policy makers both in international organizations and in individual nation states from a

[4] "The number of patents granted to investors from a particular country other than the United States by the USPTO in a given year" is used as the dependent variable (Furman et.al 2002:909).

traditional science and technology policy focus towards the importance of a broader range of national policy strategies promoting innovation and international competitiveness (Lundvall and Borras 2005, Lundvall 2006). Policies influencing only the technological development parameters such as R&D performance or expenditure are considered insufficient as innovations are now recognized as outcomes of complex processes that require involvement and interaction of various actors fostering new knowledge, competencies and practices. For advanced countries systems are usually well functioning, but often in need of change or reform depending on changing global technologies and economic circumstances. For developing countries, on the other hand, the quality of institutions and their interrelationships may be much less developed and articulated. Policy makers in less developed countries are challenged by the task of developing policies oriented to building up national innovation system elements and interactions in situations where public and private institutions are weak and suffer from a lack of historic experience and capacity.

2.5 The National Innovation System Framework in Developing Countries

The success of the NIS approach in measuring system characteristics and performance in industrialized countries and in developing better technology and innovation policies has made it tempting to apply the framework to developing countries. The NIS framework of assessment and analysis is open to history, context and unique national structures. In this sense it is an advance over other theories and best practice policy studies. What most of the studies, however, have missed is that while national innovation systems is an ex-post concept in industrialized countries; it is an ex-ante concept in developing countries (Arocena and Sutz 2000). In advanced countries, the concept is ex-post since it analyzes legible features of strong and diversified systems with well-established institutional and infrastructural attributes and clear outcome measures focused on product innovation. The concept is ex-ante in developing countries since innovative activities and institutions at the national level are not well formed, have limited histories and tend not to work together in complementary and systematic ways. Innovations, defined in strict sense of new products or process breakthroughs that may be patentable are not common in developing countries. Institutions, both public and private, have few connections and have limited power to influence national competitiveness relative to the more fully developed national innovation system frameworks in advanced market economies. Therefore, when national innovation systems are examined within the context of developing countries, the system construction or building processes must be the key object of analysis to better understand newly emerging dynamics that might lead to increased innovation in existing or emerging industries (Arocena and Sutz 2000, Lundvall et.al. 2002). The application of the NIS framework in general must focus on the potential of new institution building and institutional arrangements fostering interactions versus historic performance.

The NIS literature on developing countries shows that the framework is applied in two distinct forms. The first approach attempts to explain the main aspects of national innovation systems (Shulin 1999, Arocena and Sutz 2000, OECD 1999). According to this group of studies, the strength of national innovation systems in developing countries are correlated with their economic and institutional development levels. National innovation systems in developing countries are much less mature in terms of institutional composition, the sophistication of scientific and technological activities and linkages between organizational units (Shulin 1999:43). Because of more limited institutional support and capacity learning to innovate is more closely related to capital accumulation and learning by doing than new knowledge and product generation through dedicated R&D activities. Also, purposeful strategic management is generally not sophisticated in less developed national innovation systems due to lack of long-term planning capabilities and experience. But despite discouraging limitations for developing countries, NIS has given leaders a valuable framework to understand challenges and to promote policies to deal in more effective ways with specific and unique deficiencies in developing countries (Arocena and Sutz 2000:59). Whether the system can be purposefully designed or not, awareness with respect to the role of innovation in development processes encourages policy makers to evaluate their systems and make deliberate policy choices to change existing factors that may hinder technological development.

The unfavorable conditions in less developed countries due to the ex-ante nature of innovation systems necessitate an approach that integrates the national innovation systems framework with the developmental state theories. As the developmental state theories show there is a significant body of literature explaining the importance of institutional successes and failures in economic and industrial development (Amsden 1989, Wade 1990, Bardhan 1996). Many newly industrializing countries, despite inadequacies in institutional composition or the scale scientific activities, may also have promising institutions such as quality universities or forward looking government agencies that might facilitate the innovation system construction processes. Yet coordination among the actors, which is the essence of the NIS perspective, is not assured by the existence of these isolated institutions. A strategic approach and a lead organization is needed to better educate and coordinate various public and private sector actors and create an impetus toward common objectives. These orchestrating initiatives often involve developing basic policies that regulate user-producer relations and facilitate joint R&D activities to leverage strengths of isolated firms and public institutions.

Government support must be linked to some notion of national industrial development policies. If nascent innovation policies are disconnected from national development objectives, they become inefficient in terms of achieving the stated targets. The emphasis in the NIS framework on building both elements and interrelationships might be useful in advancing more flexible and interactive modes of behavior which is also the essence of the more contemporary model of the flexible, supportive developmental state.

The second approach studying NIS in developing countries analyzes the specific country cases by either examining the existence of innovation system components or identifying the strengths and/or weaknesses of "system" level performance in specific cases (Intarakumnerd et.al. 2002, Alcorto and Pere 1998, Radosevic 1999, Viotti 2002). Several studies find the application of the concept to developing countries relevant and illuminating in specifying the existence of weak and fragmented systems in Thailand and Latin America respectively Intarakumnerd et.al. (2002) and Alcorto and Peres (1998). Rodosevic (1999) finds the concept applicable in terms of catching-up and growth purposes but he stresses the non-existence of coherent national and regional innovation systems even in middle-income countries in Central and Eastern Europe. In contrast, Viotti (2002:654) critiques the application of the NIS concept as an analytical tool in technologically less developed countries. According to him, national innovation system approach is inappropriate to deal with "the processes of technical change in industrializing economies, which are extremely different from those of industrialized countries". In developing countries, innovation is characterized more by organizational change, learning from imported technologies and incremental product improvements rather than classic product or process innovation tied to dedicated R&D. Therefore, instead of innovation systems, a learning system framework is better to analyze and understand the knowledge embodied in operational strategies of leading firms and their suppliers and their broader institutional linkages in developing countries.

These studies have contributed significantly to possible applications of the NIS framework in developing countries. But while thinking in terms of system construction, explaining specific characteristics and evolutionary development processes of individual actors in the system offers limited conceptual or policy guidance for decision-makers in less developed countries. Considering the ex-ante nature of the issue, national innovation systems in developing countries need to be investigated at various levels integrating the national, the mesoeconomic[5] and microeconomic dimensions, (Cimoli and Dosi 1995) that highlight the type and importance of institutional interactions as the national innovation systems are constructed.

Clearly then, the applicability of the national innovation system framework to developing countries requires a specific understanding of the status of technological change and innovation given the level of industrial, technical and educational development in a country. It also requires a consideration of how state institutions and actors attempt to structure technology and industrial policies to increase the pace and impact of innovative activities. All of these investigations necessitate a macro level analysis at the level of the nation state. However, if, as the new growth theory suggests, knowledge is bounded over some period of time within economic regions, then innovative activities are likely to demonstrate distinct regional concentrations. As such,

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[5] National innovation system approach recognizes regions as important economic bases of coordination at the meso (between local and national) level. As Lundvall and Borras state "the region is increasingly the level at which innovation is produced through regional networks of innovators, local clusters and the cross fertilizing effects of research institutions" (Lundvall and Borras 1997:39). In developing country contexts, regional frameworks might be utilized as a bottom-up perspective to better comprehend construction process of national innovation systems.

sub-national regions as crucial units of analysis can be put forward as an additional necessary framework to better understand national performances.

2.6 Regional Agglomerations and Regional Innovation Systems

As the late development and more recent state developmental theories indicate, nation states through their targeted trade, industrial and innovation policies are able to influence the sources of national competitiveness and development. The countries that base their industrialization strategy on dynamic competitive advantages instead of static comparative advantages (Dosi, Pavitt and Soete 1990) are cognizant of the fact that conditions that generate and foster technological knowledge have to be created and it takes consistent effort, investment, and time. As noted above, earlier state development success stories such as Japan and South Korea were based on national industrial, trade and technology policies that focused on large firms and industrial sectors. There was very little emphasis on smaller firms and very little consideration of economic regions as discrete objects of analysis or policy making. The limits of these earlier state led development strategies that began to sharply emerge in the early 1990 directed attention to more complex and extensive firm architectures encompassing small and large firm producers and suppliers and to specific agglomeration economies and innovative practices in industrial districts and regions.

At the micro level, firms are considered as the essential agents in complex systems where learning occurs through continuous interactions among different actors. The evolutionary approach recognizes individual firms as unique actors with a primary role in innovation and technological improvement. They are "dynamic, evolving and quasi-autonomous systems of knowledge production and application" (Spender 1996:59) with particular knowledge assets whose effective management, maintenance, integration and updating affords competitive advantage (Tsoukas and Mylonopoulos 2004:1-2). The uniqueness of firms engaged in innovation derives from the particular behavioral routines they follow (Nelson and Winter 1982, Dosi and Malerba 1996) which differentiate themselves within the complex environment they function. Along with their different routines, firms develop dynamic capabilities (Teece, Pisano and Shuen 1997, Eisenhardt and Martin, 2000) concomitant with their strategies, knowledge assets, and available financial and technological resources. The ability of the firms to develop these capabilities is highly dependent on their internal capacities and the capacities of surrounding institutions to absorb and exploit knowledge and technologies (Cohen and Levinthal 1989). Supporting and building up these absorption capacities are essential in the process of development as firms and support institutions need to understand and learn the basics of new technologies while using them to generate endogenous capabilities to innovate to build on existing technologies and knowledge[6].

The strong linkages between the absorptive capacities of firms and their dynamic competitive advantages rely heavily on firms' available knowledge base and knowledge outside the firm which can be accessed. The accumulated knowledge in firms and extra-firm institutions in a specific geography puts into relief the importance of geographic concentration and proximity for innovation and competitiveness at the regional level as firm performance can be influenced by external economies of agglomeration including acquisition of highly talented workforce, localization of specialized suppliers and spillover of knowledge among local actors. Geographic proximity in this respect,

[6] The capability approach suggests that absorptive capacities of firms in developing countries are generally low since they follow a technological path that is built on low-tech commodity production due to lower access to capital, technology and knowledge. Enhancing absorptive capacities of firms in developing countries is not enough by itself as firms are immersed in an institutional setting that they co-evolve with. The institutional setting comprised by the political, commercial, financial and industrial institutions in a country form the "social capabilities" (Abramowitz 1986), the competence of which determines the future possibilities of growth and competitiveness as they shape firms' dynamic competitive advantages.

cultivates not only traditional agglomeration effects which arise primarily from access to a collective set of resources such higher quality productive factors at lower prices (Krugman 1995) but also knowledge associated externalities and spillovers[7] (Marshall 1920).

Since Marshall in the late 19th century, regional agglomerations were thought to yield positive externalities that improved the competitive prospects of resident firms. Classic economies of urbanization were seen to benefit all firms in larger urban regions due to reduced costs of supplier matching and shared infrastructure. In addition, economies of co-location benefited groups of firms in the same or similar industries and were tied to lower unit labor costs due to labor pooling, reduced cost of inputs and technology and localized knowledge spillovers. Firms benefited from being located in a historically developed industrial area, as knowledge is created and transferred more effectively due to proximity[8].

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[7] Fritch (2000) explains the geographic distribution (centre-periphery scheme) of innovation activities by two main reasons: "First, spatial clustering of innovation activities of a certain type or in a certain technological field is usually associated with a well developed supply of the needed inputs such as differentiated labor markets with specialized qualifications, a rich supply of innovation related services, and the easy availability of information relevant to innovation activities. Secondly, it is argued that knowledge spillovers that are generated by innovation activities are concentrated in areas close to their respective source. Spatial proximity to many such sources enables an innovator to benefit from a higher level of knowledge spillover than that available in a more remote location far from other innovators active in the technological field relevant to him".

[8] Relatively recent works in economic geography that provide evidence on the causal links between spillovers and innovation. These studies note that knowledge spillovers from R&D and human capital investments are spatially bounded over a period of time. (Jaffe et.al 1993, Adams and Jaffe 1996, Audretsch and Feldman 1996, Jaffe and Trajtenberg 1999). For instance, Jaffe et.al. (1993) study the localized corporate and university patent citations and confirm the existence of knowledge spillovers. Similarly, Adams and Jaffe (1996) examine the effects of knowledge spillovers on the productivity of firm R&D and affirm the importance of spatial proximity in most instances. Audretsch and Feldman (1996) search for the spatial concentration in knowledge-intense industries (measured by industry R&D, human capital and academic research) and reaffirm the prevalence of knowledge spillovers among these industries. And, Jaffe and Trajtenberg (1999) analyze the international knowledge flows by using citations and confirm localization of these knowledge flows.

Knowledge spillovers intensify the propensities of co-location as they stimulate available innovation and learning which often emerge through firms' incremental efforts to build on existing stock of knowledge within the region. Knowledge spillovers take place mostly through joint projects, consultations, personal contacts and workforce mobility among firms. Experience based competence which involves specific, tacit knowledge, on the other hand, is mostly carried out through informal gatherings where managers and workers have the opportunity to discuss their experiences face-to-face regarding specific problems and/or achievements on product development or production methods and technologies with actors from outside the firm.

The power and influence of geography on knowledge activity increase as knowledge moves along the continuum from codified to tacit knowledge. Codified knowledge, which in most instances is treated synonymously with information that is easily transmittable in formal, written formats such as patents, software codes, technical drawings or formulas, does not require interpersonal interaction (Howells 2002, Choo 1998, Nonaka and Takeuchi 1995). Tacit knowledge, on the other hand, stems from direct, informal experience that are often intuitive, not fully articulated, and hard to put into artifacts (Rooney 2003). As Howells (2002:872) elucidates "it represents disembodied know-how that is acquired via the informal take-up of learned behavior and procedures". Tacit knowledge cannot be easily transmitted and assimilated through impersonal channels such as the internet or telephone[9]. Tacit knowledge exchange benefits from face-to-face interaction to pass on implicit aspects and a strong motivation

[9] Cowan, Foray (1997) and Cowan, David, Foray (2000) consider tacit knowledge as an important strategic asset as it allows for better exploitation of the codified knowledge. Firms, depending on the industry they belong to, need some type of tacit knowledge to understand and internalize the content of the external codified knowledge. The degree of tacitness depends on the cohesiveness of the knowledge receiver as it might be perceived as clear as a codified document if articulated in the right context.

and capacity on the side of the recipient especially when the inherent complexity is high as in the case of technological knowledge.

The inherent complexity and "incompleteness" of new technical insights is the main reason for knowledge to be confined to certain geographies because diffusion of tacit knowledge requires more persistent and direct interactions that are easier to achieve with closer proximity of actors and institutions (Iammarino and McCann 2006:1025). Tacit technological knowledge, which is hard to convey through by conventional communication channels does not flow freely in the air and quite the opposite, it actually "sticks" inside specific firms and institutions (von Hippel 1994). New technical or industry specific knowledge is generated by people and teams within departments as firms work on developing new products that evolve from their accumulated experience[10]. This sticky technological knowledge leaks or spills over firm boundaries as a result of the interdependencies between firms, either through labor mobility, joint project development or more informal relations in a place. Although knowledge producers often intend to fully appropriate the benefits of new technological knowledge by preventing access without explicit compensation, it is usually difficult due to non-excludable nature of knowledge (Teece 1986, Fischer, Diez and Snickars 2001).

Empirical evidence suggests that knowledge spillovers show a local character in many cases that leads to technological innovations being concentrated in specific

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[10] Audretsch (1998) puts into words the connection of sticky knowledge inside firms with knowledge worker mobility as follows: "If the scientist or engineer can pursue the new idea within the organizational structure of the firm developing the knowledge and appropriate roughly the expected value of that knowledge, he or she has no reason to leave the firm. On the other hand, if he places a greater value on his ideas than does the decision-making bureaucracy of the incumbent firm, he may choose to start a new firm to appropriate the value of his knowledge. In the metaphor provided by Albert O. Hirschman (1970), if voice proves to be ineffective within incumbent organizations, and loyalty is sufficiently weak, a knowledge worker may resort to exiting the firm or university where the knowledge was created in order to form a new company. In this spillover channel the knowledge production function is actually reversed. The knowledge is exogenous and embodied in a worker. The firm is created endogenously in the worker's effort to appropriate the value of his or her knowledge through innovative activity." (Audretsch 1998:21).

territories over certain periods of time (Maskell and Malmberg 1999). Many frameworks such as regional innovation systems (Asheim and Isaksen 1997, Braczyk et.al. 1998, Cooke 1997, Cooke 2001, Fischer et.al. 2001, Diez 2002), clusters (Porter 1998), industrial districts (Becattini 1992), learning regions (Morgan 1997), and innovative milieu (Maillat et. al 1996) attempt to explain the aforementioned association between space and knowledge spillovers with respect to generation of new technologies and regional competitiveness. These conceptual frameworks resemble to each other in many respects[11].

The regional innovation system framework stands out among the others because of the emphasis it puts on the existing institutional infrastructure with respect to generation of innovations through actors who are systematically engaged in interactive learning. The RIS concept is sometimes described as "reduced-NIS" (Hertog, Bergman, et.al. 2001) as it transfers the loci of fundamental associations among the actors from the national to the regional scale. However, it can potentially enrich the macro focus of NIS because it emphasizes the need to understand how regional institutions and relationships relate to and influence national development processes[12]. The RIS concept owes the rise

[11] The common denominator is the importance of local agglomerations in knowledge and technology spillovers. Proximity among the actors, who are surrounded by common sets of rules, norms and conventions, stimulates the process of knowledge creation and dissemination. Regions are hence a crucial unit of analysis for learning economies as they contain specific localized resources such as skilled labor force, education and training systems, supplier networks, special financing institutions, trade associations and local support agencies. Specialized local institutions and knowledge provide an environment that incubates innovations and stimulates innovative capabilities. (Malmberg and Maskell 2002).

[12] Cooke et.al (1997:489) explains the influence of different body of thoughts on the concept of regional innovation systems as follows: "The origin of the concept lies in two main bodies of theory and research. The first is systems of innovation research; the second is regional science, with its interest in explaining the location distribution and policy impact of regional high tech industry, technology parks, innovation networks and innovation programs. The onset of 'co-makership' supply-chain relationships amongst firms and their contribution to cluster formation, to some extent concentrated in regions, opened up the way to exploring the extent to which innovation processes at regional level could be defined as systemic, and the two intellectual levels be united".

in its popularity both to the wide acceptance of the NIS at different levels of national and international policy making and to the inadequacies of traditional regional development policies in coping with the requirements of intense international competition in a globalized world.

Similar to national framework's emphasis on national capabilities, the RIS attempts to explain the innovative capabilities of regions by focusing on existing interdependencies among firms and institutions whose interactions develop a special form of social capital and learning that reinforces the competitiveness of regions (Asheim and Isaksen 1997, Autio 1998, Braczyk et.al. 1998, de la Mothe and Paquet 1998, Howells 1999, Acs 2000, Cooke 2001, Isaksen 2001, Cooke et al 2000, Doloreux 2003). The RIS concept does not have a simple definition, but the main idea is based on the premise that "[a set of actors] produce pervasive and systemic effects that encourage firms within the region to develop specific forms of capital that is derived from social relations, norms, values and interaction within the community in order to reinforce regional innovative capability and competitiveness" (Gertler, 2003 in Doloreux and Parto 2004:9). The RIS framework holds that knowledge is locally bounded and competitive advantages of regions depend on the quality of existing localized resources such as a specialized labor force, advanced research and training institutions and a unique environment and culture supporting innovation. The interaction of these elements shapes the ability generate externalities to enrich the collective learning processes in regions[13] (Cooke et.al 1998:1581).

[13] The embeddedness idea lay emphasis on systemic interactions and "systemic qualities" when regional innovation systems are perceived as cultural constructs. Cooke et.al (1997:488) lists the cultural aspects linked to "systemic quality" in an innovation system as follows: culture of cooperation, associative culture, learning culture, experience and ability to carry out or incorporate institutional changes, coordination and public/private consensus, productive culture (labor relations, cooperation at work, company commitments to social well being, productive specialization), existing interface mechanisms (in the scientific, technological, productive, financial fields), different types of learning capacity, social valorization of the

The regional innovation systems framework encompasses two important concepts, clusters and networks. Industry clusters and networks have received significant attention among policy makers as a specific form of agglomeration. Both concepts emphasize how cooperation and competition among firms in the same or related industries allow a mechanism for small to medium-sized firms to compete in domestic and international markets (Nanoka 2004, Ingley 1999). The concepts of networks, clusters and regional innovation systems are inherently related. Clusters encompass networks and regional innovation systems encompass both clusters and networks. As the core mechanisms that make up the whole systems, networks are studied in different contexts such as a new form of governance in a regional industrial cluster (Turnbull et.al. 1996). Networks describe new organizational structures that result from various relationships. They characterize different forms of inter-organizational interactions among a number of economic agents including buyer-supplier relationships, R&D collaborations, different forms of ownership agreements such as joint ventures, or sharing of testing and training centers and many others that stimulate the flow of resources, embedded knowledge and/or scientific know-how (Ozman 2002). Industrial networks are dynamic in nature and they develop and prosper as the intensity of interactions increases. Firms benefit from being parts of the networks because knowledge externalities and learning rise with increased interactions resulting in more rapid and efficient technology development (Evangelista et.al. 2002). However, networks as forms of inter-firm linkage and governance frameworks do not have an explicit geographic focus. Network relationships can emerge and evolve at the regional, national or international levels.

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use of science, university linked to the productive system, non-bureaucratized educational and training system linked to the productive system.

Clusters, on the other hand, add a specifically spatial dimension to the network approach and highlight benefits of geographically concentrated firms and institutions in a particular field (Porter 1990). Although the idea of competition through cooperation to achieve economic advantage among agglomerated firms is not new and goes as early as back to the 19th century, the industrial clustering approach reintroduced the value of a geographically proximate group of firms and institutions which are linked together through complementary expertise revealed by information and products flows. Physical proximity among closely linked industries leads to extensive investments on specialized factors of production over time promoting positive externalities that trigger innovation and growth. The focus in the cluster approach is based on mutual geographical or functional links among firms in individual industries which are vertically and horizontally[14] connected with other firms and institutions that share similar objectives with respect to industry growth (Cooke 2001). While this consciously adopted, intense networking based approach can serve as a local economic development strategy, it also stimulates capacity building efforts of firms to achieve global competitiveness. Commonalities and complementarities such as shared human capital or labor pools, common technology, common distribution channels and production of complementary goods and sharing of complementary facilities respectively increase the potentials of interdependent firms in specific sectors, to compete in international markets. And, such interconnections necessitate existence of mutual trust relationships that also benefit from proximity (Albu 1997).

[14] While vertical links refer to links between firms at different levels of the production chain such as the relationship between customers and suppliers; horizontal links refer to relationships between peer firms at the same level of production chain.

Regional innovation systems overlap with but are different from the industrial clusters (Todtling and Trippl 2005:1206). Incorporating the networking and collaboration arguments of industrial clusters, the RIS framework puts more emphasis on how horizontal linkages between firms and the extra-firm support structure function collectively to stimulate local growth. Industrial clusters frequently embody specialized sectors and emphasize importance of firm interactions to increase competitiveness, while the regional innovation systems framework additionally accentuates systemic learning processes and improvement in absorptive capacities of firms located region-wide, not just in select industrial sectors. The regional innovation system concept has received considerable attention with its emphasis on broader linkages and especially the quality and importance of interactions between public and private institutions and actors, but has also been critiqued as a "fuzzy" framework (Markusen 1999) as it does not offer a generalized model that would fit in diverse cases. The ambiguity in RIS studies is related to vague and inconsistent descriptions of economic regions and associated governance and policy-making structures. Nevertheless, the flexibility of the concepts also has advantages because framework elements can be applied to analyze and evaluate any region that focuses on building social and institutional relationships to support technological upgrading and innovation in resident firms.

Any region can be seen to have some kind of an innovation system as long as the region contains a certain degree of agglomerated productive forces embedded in local institutional structures with certain localized and/or non-localized learning processes influencing its capability to innovate (Kaufmann and Todtling 2001, Dolereux 2003, Wigg 1999). The amount and intensity of interactions vary according to the peculiar institutional and policy characteristics of regions and thus adherence to a single and cohesive framework in reality is hard to observe or operationalize. The empirical studies which contribute to identification and clarification of the regional innovation systems framework in different contexts confirm that the concept cannot be defined too rigidly because it applies to many possible operational types. As Cooke (2001:14) denotes, it must be "sufficiently generic to enable innovation systems to be distinguished from non-systems, non-regions and non-innovative settings".

Different types of regional innovation systems bring clarification to the functioning of a variety of RISs. For instance, Cooke (1998) puts emphasis on the governance infrastructure and business association dimensions which can be grassroots, network[15], dirigiste; and have a localist, interactive or globalized business relational structure respectively. Even though the governance structure in Cooke's typology connotes political governance, it actually refers to the organization and management of technology transfer activities. In this respect, the different modalities of governance are analyzed according to the types, levels and degrees of funding, research, technical specialization and coordination among actors. While the grassroots model refers to a region where technology transfer is locally organized at a city or district level; funding is diffuse, mostly comprising a variety of local grants and loans; research competence is applied and knowledge is synthetic[16]; technical specialization is low; and the degree of supra-local coordination is weak. The dirigiste innovation model lies at the other end of the continuum and appears in a region where technology transfer institutions and

[15] In Cooke's 'network model' or Asheim's 'regionally networked innovation systems', actors are deeply embedded in regions as in the cases of 'grassroots' or 'territorially embedded innovation systems',. The interactive learning is still the most defining feature of the innovation systems. However, here, institutional infrastructures, such as R&D institutions, universities, technology transfer organizations and business associations are highly involved in firms' innovation processes. The interactions among them are consciously supported through policies and institutional support to increase innovation capacities and competitiveness of regions.

[16] Based on Laestadius (1998), Asheim and Gertler (2005) differentiate synthetic knowledge base from the analytical one. In distinction, while analytical knowledge rests on creation of new scientific knowledge base which is conducive to more radical innovations, synthetic knowledge emerges from more practical, problem related engineering knowledge generating incremental innovations.

activities are mainly initiated from the central government. In this form funding is centrally determined; research is basic and in most cases detached from the direct needs of the industry, and technical specialization and degree of coordination is relatively high as they are shaped by central government policies (Cooke 1998:20-24).

Grassroots and dirigiste modalities also resemble other characterizations in the RIS literature such as Asheim's (1998, 2005) 'territorially embedded innovation systems' and 'regionalized national systems' and Howell's (1999) 'bottom-up systems' and 'top-down systems' respectively[17]. These typologies have increased applicability and value of the RIS approach because they are rooted in studies analyzing RISs in different regional and national contexts. A number of studies have investigated specific regional cases and distinguished the observed, operational regional innovation systems from the abstract conceptual frameworks offered in the literature (Asheim 1998, 2005; Cooke et. al 2000). These studies examined individual RISs and their corresponding resemblances to a true regional innovation system by analyzing the main institutional dynamics that promote technological innovation[18] (Asheim and Coenen 2005:1186). The need to investigate the specific roles that regions play in the context of less developed regions also motivated a

[17] Grassroots, territorially embedded innovation systems and bottom-up systems share the common characteristics of strong local networking among customers, suppliers and support institutions in enhancing the competitive advantages of regional firms and industrial sectors. Localized inter-institutional learning processes are highly embedded in the regional business culture and are perceived as the main sources of ongoing innovative activities. In these innovation systems, more formal knowledge-generating organizations such as universities or public and private R&D institutes have less important roles compared to the other forms. Dirigiste, regionalized national systems and top-down systems, on the other hand, emphasize strong influences of central decision-making authorities in shaping local institutional structures and productive resources, especially in the way firms, science and technology and R&D systems are organized to enhance the competitiveness of regions. Planned science parks and technopoles linked to larger scale research institutes and sponsored by national or higher-level governments are typical examples of these centrally initiated regional innovation systems.

[18] An important issue that needs attention here is that the empirical studies which constituted the basis of the widely accepted RIS typologies are mostly the ones examining regions that are functioning within strong national innovation systems.

set of comparative studies which examined the determinants of innovation in less developed regions. These studies compared regions with their advanced counterparts to reveal the presence and importance of specific networks and interactions seen to be critical to regional innovation in advanced countries (Doloreux 2002; Cook et.al. 2000). Lack of associated interactions and low innovation potential in institutionally less dense settings are used as controls to explain the effects of more intense networks in stimulating innovations in interactive regions.

The specific characteristics of sub-national entities set apart regions form aggregate national processes even if they are influenced by powerful unifying and institution building flowing from national level policies. Asheim and Coenen (2005) note the importance of national and regional interdependencies in NIS and RIS perspectives:

> "In a globalizing economy characterized by vertical disintegration and distributed knowledge bases, the important perspective ought to be the interdependencies between regions and nations, where the deciding criteria must be the location of core activities (and not the whole value chain as such) and the relative importance of their connections to regional knowledge infrastructures" (Asheim and Coenen 2005:1178).

At the regional level values, norms and established routines influence the character of interactions among firms and their embeddedness within the web of local innovation support structures (Willke 2000). Certainly, institutions, together with firms and technology supporting or transferring organizations, are one big important component of regional innovation systems as they set the rules for firms involved in interactive learning processes[19] (Amin and Thrift 1995; Maskell 2001). They, however, do not inherently

[19] "The institutional thickness concept, for instance, which takes the thickness of institutions as its starting point of analysis, was launched after scholars found out that successful industrial districts in Europe are characterized by a "thick" issue of support institutions. Institutional thickness, which nourishes relations of trust, is characterized by inter-institutional interactions and synergy, collective representation by many bodies, a common industrial purpose and shared cultural norms and values. (Amin and Thrift 1994:15 in Hassink 2002:155)

offer an environment conducive to generation of innovations due to potential regional "lock-in" effects. Institutions may suppress development as they support inertia to carry on existing routines and ways of doing business versus fostering dynamism and the establishment of new routines favoring innovations (Johnson 1992). The strength and performance of regional innovation systems is hence always contingent in their ability to address new challenges, learn and adapt, and overcome common frictions and incoherence often associated with regional production and innovation processes[20] (Heidenreich 2004).

Depending on their ability to deal with contingencies and uncertainties with respect to their capacities for innovation, new knowledge generation and ongoing networking, some regional systems may be highly developed as in the cases of Silicon Valley, Emilia-Romano or Baden-Wurttemberg or some may show very weak and fragmented system dynamics in other regions in the advanced or developing world (Kyrgiafini and Sefertzi 2003, Figueiredo 2007). In any case, an innovation system is present in different types of regions with certain production and innovation capabilities and its dynamism and efficiency to drive competitiveness is subject to some extent on targeted regional innovation policies (Todtling and Trippl 2005).

2.7 The Role of Regional Innovation Systems in National Development

Given the historic significance of regional agglomeration economies in the process of technological improvement and innovation, national innovation system

[20] In his "the dilemmas of regional innovation systems" chapter, Heindenreich (2004:363) argues that the fundamental dilemma of innovations is that "satisficing (even if not optimal) results can be obtained with previous routines, products, technologies, and institutions, while new routines, products, technologies and institutions require extraordinary investments and the outcomes remain uncertain". Based on thirteen case study regions, he elaborates the dilemma argument and reconstructs four dilemmas territorially bounded innovations are confronted with. He also provides different dealing mechanisms according to different types of regional innovation systems such as grassroots, networks and dirigiste RISs.

construction in developing countries necessitates consideration of regional systems of specialization and institutional interaction. Within the context of advanced countries, regional and national frameworks have been frequently used as complementary frameworks. While the national framework emphasizes policy making capability and power to allocate funds affecting strengths of actors in the system (Niosi 2002), the regional framework highlights inherent characteristics of regions with respect to their potential to generate and transfer knowledge to create competitive advantages in higher scale national and global markets (Ohmae 1995).

Within the context of developing countries, the RIS literature presents three major approaches to the study of how innovation support systems are developed and evolve to enhance the technology absorption capacities of regional firms. The first approach emphasizes the significance of institutions and policies developing regional innovation support systems (Hassink 2002) and absorptive capacities (Asheim and Vang 2005) endogenously within the region. It also focuses on improving the capacities and linkages between small and medium sized local firms and between these firms extra-firm regional support institutions. As Hassink (2002:153) articulates,

> "innovation support systems are … a group of actively cooperating organizations that support the innovativeness of SMEs. An innovation support system consists of all agencies found in three support stages, namely the provision of general information, technological advice, and joint R&D projects, between firms (of which technology following SMEs are the main group), higher education institutes (HEIs) and public research establishments (PREs). Agencies found in these stages try to help to solve innovation problems mainly of technology following SMEs by either giving them advice directly or by referring them to other agencies in a further stage of support".

This regional innovation support systems approach presents an endogenous model to increase technological adoption and innovation within the economic region. However in the developing country context, endogenous capabilities are often weak and uneven and outcomes can vary dramatically, even though regions may apply similar innovation policy instruments. Their abilities to coordinate policies into integrative support systems determine the nature of development. In this model these abilities are shaped by the type of political-administrative systems in the regions, the commitment of local leaders, collective trust, historical context of development policies and mechanisms supporting firms (Hassink 2002). In many middle income countries administrative systems may be centralized and the capacity and experience of regional leaders and public and private sector actors may be quite limited.

A second model accepts the fact that local capacities and institutions may be limited and highlights the necessity to connect with larger more advanced firms in global production networks. This approach stresses an exogenous approach to regional development by introducing external knowledge sources and transnational corporations as a critical means for technological improvement and capacity building among regional firms and institutions (Asheim and Vang 2005). Traditionally, power of regional innovation systems framework rests in its potential to mobilize endogenous economic and institutional sources. However, in developing country context with potentially weak local capacities, external sources of technology, knowledge and capital through transnational corporations can serve as a more powerful development channel. Attracting transnational corporations to a region and more importantly embedding them within the local production networks is seen as crucial in building a regional innovation system. However, positioning local firms to link to a participate in global supply networks is challenging and requires specific efforts to increase capacities of local firms to build traded and untraded interdependencies with transnational corporations.

According to Asheim and Vang (2005), building regional absorptive capacitates necessitates improvements in available physical, social, human and financial capital and it goes beyond simple aggregations of the absorptive capacities of individual firms. In this model, building regional absorptive capacity requires a systemic perspective in which:

> "absorptive capacity building is about investing in formal training (human capital) including vocational training and possibly engaging in collaboration (i.e. interactive learning) between firms and universities (not necessarily co-located universities due to high reliance on codified practices and modular processes). It is also about interacting with other organizations (other firms, universities, etc.)…[which] allows firms to develop their internal absorptive capacity as well as utilizing other firms' and organizations' competencies" (Asheim and Vang, 2005: 30).

The approach emphasizing external links and the building of absorptive capacities in existing institutions is valuable in the developing country context with weak local capacity. However, this approach is vague about what sort of policies or mechanisms are needed to achieve human and social capital upgrading. It can be assumed that central governments have an important role in burnishing local assets in developing countries considering limited capacities of regional political-administrative systems (Cooke 2001). Besides, the prominent role of transnational corporations as a means to achieve regional economic development through technology and knowledge spillovers is still the subject of intense debate in the literature[21]. In this respect, it is questionable to assume that

[21] Technology spillovers from foreign direct investment have increased attentions of scholars since the mid-1970s in many different aspects. (Caves 1974; Globerman 1979; Grether 1990; Harrison 1994; Koko 1994; Aitken et.al 1996; Blomstrom and Koko 1998; Blomstrom and Sjoholm 1999; Aitken and Harrison 1999; Djankov and Hoekman 2000). The numerous studies conducted on the subject indicate mixed evidence though.

The studies supporting existence of spillovers (Cave 1974, Globerman 1979, Blomstrom and Koko 1998, Blomstrom and Sjoholm 1998) argue that countries try to attract FDI to acquire modern product and process technology and marketing and managerial skills. Operation of MNCs increases "allocative efficiency", "technical efficiency" and "technology transfer". Allocative efficiency means increasing competition in industries with high entry barriers by removing distortions in the market; while technical efficiency implies an increase in the level of 'X-efficiency" (same output with fewer resources) in suppliers and competitors. Technology transfer, on the other hand, indicates spillovers which are identified by the productivity and market access spillovers (Blomstrom and Koko 1998:249). Productivity spillovers occur "when the entry or presence of MNC affiliates lead to productivity of efficiency benefits in the host country's local firms and the MNCs are not able to internalize the full value of these benefits". Market simply attracting and attempting to tie multinational corporations to a local economy will generate the expected dynamic set of interactions leading to technological growth and development (Chaminade and Vang 2006).

A third strategy is Feser's synergy leveraging approach. He argues that regional innovation policies be designed "to leverage synergies amongst businesses and non-market institutions as a means of increasing policy efficacy" in developing and transitioning economies (Feser 2008:191-6). As he notes;

> "… attempts to build discrete regional technology clusters as a means to promote innovation economy-wide are likely to meet with very limited success in most developing and transitioning economy contexts. … The case for exploiting interdependencies to improve the effectiveness of innovation programs and policies is much stronger conceptually, and regional technology-based clusters may very well emerge naturally as a result. The distinction is not a trivial one, especially for less favored regions where existing innovation clusters are nonexistent or very shallow and the potential for wasting scarce resources is great".

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access spillovers arise due to local firms' linkages with export oriented MNCs that "provide knowledge about product and process technologies and foreign market conditions". Productivity and market access spillovers can be realized through many ways such as forward backward linkage, imitation, training, and competition effects. Domestic firms, by providing inputs to MNCs learn their and other international firms' preferences regarding design, product quality and deliveries times, and follow these in their own operations. Local firms through informal channels or some sort of inter-firm collaboration imitate technological and organizational practices of MNCs. Domestic firms also take advantage of the training effect which occurs when domestic workers build up experience and knowledge in MNCs and then leave to set up their own business in order to exploit their accumulated knowledge. Also, existence of MNCs in the market may act as incentives for domestic firms to adopt new product and process technologies to compete more effectively in the market.

It should also be noted that spillovers do not occur one way, only with the presence of MNCs in domestic markets. The characteristics of local firms are also important for the existence of spillovers such as their ability and willingness to learn and invest on technology and training depending on the size of technological gap between the firms and countries. Lack of willingness to change and explore the technological options may cease spillovers. The studies arguing for non-existence of spillovers, (Harrison 1994, Grether 1999, Djankov and Hoekman 2000) show that spillovers from FDI do not exist due to various reasons such as, fewer domestic employee hiring in managerial positions of MNCs, limited labor mobility between foreign subsidiaries and domestic firms, limited subcontracting to domestic firms, limited R&D activities in subsidiary firms and few incentives of MNCs to diffuse their knowledge.

The synergy leveraging approach does not rule out the benefits of innovation cluster building among specific businesses in targeted regions, but it is cautious regarding real limitations, such as presenting the notion of spatial clusters as the main objective instead of focusing on specific economic outcomes they may generate. The emphasis is on building upon actually existing institutions, linkages and interactions rather than abstract models of local or non-local clusters that may have key missing elements that do not apply in general to discrete cases or places.

Within the context of developing national innovation systems, the synergy leveraging approach warrants special attention as it can be adopted as a conscious policy tool in developing countries which use NIS framework in their development efforts to increase connectivity and interactivity among its actors. Especially in countries where regional authorities are endowed with weak administrative and decision making capabilities, central authorities can take actions to promote regional collective learning and intelligence to overcome "system failures" in various types of regional industrial agglomerations[22]. It should be noted that in all of these models the bounded rationality of policy makers impedes their ability to systematically create and organize a variety of institutions in uncertain and shifting market conditions. These intrinsic limits call for a more incremental process of policy experimentation and learning. This experimentation can pay off with the emergence of an environment of "competitive cooperation" among firms which is difficult to foster without specific policies designed with an objective to improve cognitive capacities of firms[23].

[22] Teubal (1998:156) defines a system failure as the "failure to stimulate in a timely fashion the emergence of a new component of a NSI [national system of innovation] which is deemed to be of strategic value for the economy. More generally, system failure reflect deficiencies in the set of complex activities which should be undertaken both by the policy mechanism of a country and by market forces in order to stimulate such a NSI component".

[23] According to Larange et.al (2008:829), "cognitive capacity concerns not only specific and technical knowledge, but also other kinds of knowledge, related to markets or produced in business and

In developing countries, the innovation potential of firms depend very much on their operational environment as their strategies with respect to new product or process developments are constrained by both low-cost competitors at one end and by more advanced high-tech competitors at another. While low-cost competitors exert an intense price pressure and force firms to set their final prices to maintain their existing market shares, high-end competitors increase the technological learning threshold for new distinctive products or high performance production processes through their incessant efforts to build new competences and unique advantages. In any case, knowledge, both tacit and explicit, is valuable and it is easy for firms to associate cooperation with surrendering knowledge they perceive as fundamental to their competitive position and hence survival. It is, therefore, unlikely to expect the spontaneous emergence of cooperative competition among firms leading to types of endogenous economic development emphasized by the innovative support system approach.

The synergy leveraging approach, by involving policy makers in patiently and iteratively building up the conditions and incentives for interactions is based upon actually existing strengths and weaknesses. It emphasizes the slow growth of trust based relationships among firms and other non-market institutions in a region. Through their increased awareness and learning, firms exploit potentials of the environment they function in which may be regional, national international depending on character and capacity levels of other actors functioning in the regional economy. Utilizing available resources through leveraging synergies in less developed contexts also improves policy efficiency by preventing redundant or ineffective investments because the foundation is

organizational practices. It also includes dynamic aspects related to the capacity to change the cognitive capacity, involving changing the “way of thinking”, the beliefs, the visions, the intangible resources, organizational routines and etc”.

improving performance based on existing institutional configurations and strengths, identifying and addressing gaps, and evaluating and improving policies over time.

To sum up, evaluating the three approaches to delineating the key elements of policy making to construct regional innovation systems suggests that within the context of developing national innovation systems, regional innovation potentials can be better leveraged if policies governing regional resources consider not only regional factors expected to generate endogenous growth dynamics but also national and global factors contributing to the better enhancement and utilization of local capabilities. Additionally, during the national innovation systems building process, regional systems contribute as an essential level where technological change and innovation are actually realized. Many of the earlier state-led development efforts were organized around a central authority and national industrial and technology policies with little explicit concern for sub-national regions. However in the contemporary setting of rapid technological change and globalization of production, national systems must incorporate policies that are tailored and oriented to the regional level to more efficiently exploit regional advantages. National system building efforts now almost inevitably incorporate a strategy to leverage and strengthen regional agglomeration economies.

2.8 Key Questions and Gaps in the Literature This Dissertation Will Address

This review demonstrates that processes of technological change and innovation are now recognized as central to the study of macroeconomic growth. In addition, there is a broad consensus that the economic growth process is subject to increasing returns from new knowledge generation and increases in human capital in the workforce. The quasi public goods nature of new knowledge generation and innovation opens up an explicit role for government in supporting and investing in a range of efforts to increase technological progress. Indeed, uneven national growth performance can in part be explained by the commitment and capacity of public and private sector institutions to generate and implement new product and process innovations or in the case of developing countries rapidly adopt leading edge technologies developed elsewhere. In the post WW-II era, state-led development efforts have been prominent in a number of countries that have rapidly increased their per-capita income and levels of industrial and technological development. Understanding the role of the state in the development of industrial and technology policies is hence crucial in explaining international growth patterns and technological and innovation capacities in individual countries. The most systematic and context sensitive approach to analyzing the institutions and relationships that shape technological change at the level of the nation state is the national innovation systems framework.

The review of the NIS literature in developing countries shows that the NIS framework must be employed differently due to the ex-ante nature of technology policy development in middle or low income countries. Our understanding of "system construction" processes can benefit from additional cases investigating the innovation system building characteristics in developing country contexts. This research contributes to the literature by providing a case analysis focusing on Turkey, an important middle income country that is explicitly employing the NIS framework in shaping its technology and innovation policies. This work is also unique relative to existing studies because it examines the system building features directly through the eyes of the actors involved in the process, including policy makers, innovative manufacturing firms and supporting organizations such as university research centers, technology development centers and business associations.

The late development and developmental state theories show that nation states are highly influential in national development efforts; especially technology based economic development initiatives. This is certainly true in the Turkish case where the central state has played a leading role from early industrialization efforts at the beginning of the 20th century through various plans and initiatives to enhance industrial modernization and technological progress since the late 1940s. In exploring the complex innovation system building process, the study first of all investigates the importance and effectiveness of plans and policy making in Turkey. It specifically looks at the historic role of the central government in supporting technological development and innovation. It also reviews the level of national and technical and industrial development achieved by the end of the 1990s under numerous post-WW II government technology and innovation planning initiatives. The study specifically focuses on the distinct planning, policy and institutional initiatives that characterized the new emphasis on building a NIS system beginning in the late 1990s. It also explores the specific roles and activities of key public, non-profit and private institutions in the current innovation system in Turkey and also the major difficulties and problems confronting policy makers in their efforts to accomplish to build a more effective national innovation system that improves economic development outcomes.

This will be followed by a more detailed examination of current policy initiatives shaping the NIS system construction processes. This study is specifically designed to address a significant gap in the development of NIS literature; the limited number of studies investigating interactive behaviors of system actors. In both the NIS framework and various models of innovation at the regional level discussed above, the quality of relationships and interactions is seen as crucial. In these frameworks the mere presence of formal linkages reveals little about the capacity and performance of the "system," or benefits that firms may derive from participation in programs or public-private partnerships. This work, explores the system building processes and value of various relationships through the eyes of the people directly involved in institutions that make up both the production and support structure of the innovation system.

Because the innovation system construction process is complex and multi-layered it is a challenging process to study. A comprehensive analysis would call for an extensive process of data collection among a representative sample of participants over some reasonably long period of time. This would require multiple scholars working through larger research teams. I adopt a more modest approach which focuses on understanding the historical context and understanding strengths and weaknesses in the system at one period of time based on positions and perceptions of a subset of important actors involved in the process in 2006-07. The adopted multi-level approach in this study first of all, uses regional and national innovation system frameworks and considers possible complementarities and disjuncture between national and regional processes of technology upgrading and innovation.

It evaluates numerous positions and arguments outlined in the above literature review on the relationships between national institutions and relationships and more local relationships at the level of the economic region. The study, in this way, investigates spatial considerations during system building practices, especially the importance of local versus non-local linkages and the importance of local agglomeration economies to the efforts of firms to upgrade technologies and generate new product or process innovations. The study explores presence and embeddedness of major RIS components posited in the literature among innovative manufacturing firms in the main Turkish industrial regions and also investigates strength and importance of and inter-regional (including international) networks among firms in the Istanbul, Izmir and Ankara cases. The outcomes of this investigation should also shed more light on the role of regions and regional agglomeration in technology development in developing countries. The study, combining the analysis of national policies and firm linkages and performance at the regional level hopes to uncover ways that the national innovation policy can take better advantage of existing strengths and capacities at the regional level.

Chapter 3: Research Design and Methodology

3.1 Overview of Research Strategies and Methods

Drawing upon the rich theoretical insights on the central status of technological change and innovation in national development, this work will investigate policy development processes at the national level and private firm and extra-firm institutional interactions at national, international, and regional levels to gain insights on the national innovation system construction processes in a developing country context. Cognizant of the strong emphasis in contemporary literature on crucial role of regional agglomeration processes in stimulating innovation and competitive advantage and the unique context and challenges to accelerating innovation in developing countries, the study utilizes regional and national innovation system frameworks as supplements to each other to investigate the local and non-local networking patterns of firms and institutions within major economic regions. As such, the dissertation aims to capture the dynamic interactions among the actors and identify the main barriers to the fuller development of regional and national systems of innovation in Turkey.

To better understand and evaluate the innovation system construction processes in Turkey, this study employs an integrated multi-level methodological approach. Given the focus and aims of this inquiry, a conjoined approach was required utilizing historical documents and analysis, quantitative data from secondary sources and in- depth interviews with policy makers, business assistance providers and firms utilizing technology and innovation policies and programs. To understand the contemporary system construction process at both the national and regional scales it is first essential to understand the unique historical context; how the emergence of a strong central state in Turkey has shaped the inherited structures and cultures within which technology and innovation policies are fashioned and implemented. To provide this context an historical account of central government economic planning and policy making is provided in the following chapter. The central state in Turkey (and arguably in all most developing countries) has been the main driver of industrial and technology policies, with sub-national entities playing a distinctly subsidiary role. This chapter of the dissertation addresses the first preliminary questions of this dissertation: What is the historic role of the central government in supporting technological development and innovation in Turkey; and what level of national and technical and industrial development was achieved by the end of the 1990s under numerous post WW-II government technology and innovation planning initiatives? This analysis establishes the historic context but also is an essential baseline to evaluate the contemporary NIS construction process.

Given the prominent role of the central government in shaping technology and innovation policy, it was crucial to understand recent efforts at organizing national technology policies around the NIS framework from the perspective of key decision-makers and policy implementers in the central government. Contemporary government reports, documents and legislation is analyzed to better understand the specific policy goals, instruments, and funding levels associated with the recent NIS initiatives of the central government. A number of key personnel in the relevant national agencies were interviewed to delineate the rationale and goals of recent policies and to detail their perspectives on successes, failures and needed adjustments to current efforts. Furthermore, I was interested in determining how the role of regional specialization and agglomeration was viewed by national policy makers and how (or if) regional considerations influenced policy development or design. The insights and perspectives of these actors were also evaluated in terms of secondary quantitative data on national and industrial growth performance, measures of technological improvement such as R&D and patent data, and data on regional industrial specialization and change. This section of the dissertation helps address the following main research questions: What were the distinct planning, policy and institutional initiatives that characterized the new emphasis on building a NIS system beginning in the late 1990s; and what major difficulties and problems currently confront policy-makers in their efforts to accomplish to build a more effective national innovation system?

The most extensive aspect of this research involves an investigation of the "subjects" of national innovation policies; private firms and public support institutions in the three major economic regions of Turkey. The three major industrial regions of Turkey were selected as cases to probe the character and importance of interaction between national and regional levels in policy and in the actual innovation activities of firms and institutions. These metropolitan regions- Istanbul Izmir and Ankara- were obvious cases because collectively they are dominant in terms of their shares of national non-agricultural economic activity, workforce skill levels and technological performance. While there are some other second tier economic regions in Turkey, the presence and significance of local agglomeration economies is much more likely to stand out in these major regions. For each regional "case" secondary data was used to profile industrial specialization and recent patterns of growth and change to provide general evidence of agglomerative forces.

At the regional scale, the RIS framework is referenced to study and evaluate the character of innovation networks in concrete technology upgrading and product and process innovation efforts (Cooke 2002, Isaksen et.al 2001, Muller 2001, Simmie 2001). Of central importance here is understanding whether technical and innovation collaborations show a regional or more inter-regional character, focusing on the value firms place on their local collaborations versus their non-local collaborations. Investigating institutional characteristics in these three regions allowed the interviews of firms and support institutions to evaluate the potential significance of local versus non-local interactions and the real importance of spatial scale during an early innovation system building phase.

Within each region two sets of institutional actors were interviewed extensively using structured interview protocols involving directed and open-ended questions. First, in depth interviews were conducted with institutions and service providers supported by the public sector (e.g. university innovation partners and technical assistance providers) in each of the three regions. Second, eighty-three manufacturing firms that received government support for innovation were interviewed in depth to determine firm characteristics, products, R&D activities, opportunities and barriers to innovation and importance of local and non-local linkages to their operations and innovation efforts.

More detailed rationales and justifications for this qualitative interview methodology will be outlined below, but there are three basic reasons why in-depth interviews of the key private and public sector actors is the most appropriate method to address the remaining key questions of this dissertation. First in the Turkish context, more systematic efforts to support technological upgrading and innovation are quite new and rapidly evolving. A broad based mail-out or internet survey of firms or institutions would be subject to inaccurate and distorted response because many of the terms and question content could be unfamiliar or misinterpreted by respondents. A more direct face-to-face interview process allows for meanings and queries to be clarified and reflected upon by the interviewee. Second, because the influence of relationships between institutions and actors are seen as crucial to the character and performance of the innovation system, the significance of ties and relationships must be evaluated in addition to the mere existence of relationships (Markusen, 1994). Understanding the significance of specific relationships with customers, suppliers, and public sector support institutions can best be ascertained through an intensive interview process. Third and more prosaically, surveying the large numbers of firms necessary to obtain a statistically meaningful sample through an intensive face-to-face protocol would have been a prohibitively expensive and time consuming endeavor. Following from this overview, in what follows I offer a more detailed description and justification of methods focusing on the research process, secondary data and evidence, the economic regions and the interview samples and methods.

3.2 The Research Process in the Field

Utilizing the NIS and RIS frameworks together to answer the key research questions in this work requires an understanding about factors that influence innovation and technical change at the firm level and about how innovation is related to scale and space. The research process in this dissertation required an iterative approach where strategies and methods were adjusted and refined as the field work was carried out. The basic strategy was consistent with the approach suggested by Cooke (2001) for conducting field research on regional innovation systems in developing countries.

The mixed methodology based research design strategy generally followed four steps suggested by Cooke (2001) and shared features of the research designs of other investigators in this area. The first step was examination and analysis of existing documentation on innovation and technology policies at the national level. The policy documents and plans were collected and investigated based on their discussion of science and technology issues and how to measure and build innovation based capacities and capabilities. The second step involved analysis of existing documentation on industry structure, industry strengths, employment, exports and any data relevant to competitiveness and innovativeness of regions. Simple regional analysis tools - location quotients and shift-share analysis - were used to understand industrial structure and specialization in the three study regions. This stage also included identification of the firms that will be included in the empirical analysis and interview process. The third step was identification and investigation of organizations participating and contributing to technology transfer and innovation in the regions, such as universities, research institutes, technology transfer agencies, consultants, and business associations. And the final step was examination of a randomly selected sample of innovative firms in manufacturing industries that received government R&D support in the major regions in Turkey. This stage also included in-depth interviews with representatives of the supporting institutions awarding grants and providing services to the firms.

In concert with these steps of the research design strategy, the fieldwork process consisted of three main investigation phases: Phase One: Getting acquainted with the parties involved in technology development in Turkey, Phase Two: Conducting in-depth interviews and in-depth surveys, Phase Three: Follow-up interviews. The objectives, time periods and accomplishments of research activities in each phase are described below.

Phase One: Identifying the Key Parties Involved in Technology Development and Developing the Sampling Frame of Innovative Firms in Turkey

The most important aim of the first phase of the fieldwork research was to get acquainted with the parties that were involved in significant ways with technology development and establish contacts with representatives of the major actors in the Turkish national innovation system including the science and technology council, key state planning organizations, technology development agencies, university research centers, public research institutions, innovation relay centers and university entrepreneurship development organizations. This was an important and surprisingly challenging task because the rules and roles of older institutions were changing and new organizations were being established over the study period. Once the institutions forming the national innovation system in Turkey were known, identifying key people in these institutions guiding and/or influencing the development and implementation of technology and innovation policies was also challenging in the beginning of the field research. The introductory phase helped establishing closer relationships with many officials in these institutions that helped to establish access to important respondents during the data collection phase of the study.

The first phase was also a preparation stage for the second phase of the study specifically for understanding the policy context facing firms and using this information to shape the firms interview process. In this respect, data on the industry structure of the three regions were gathered from the Turkish Statistical Institute (TUIK) and were used to detail industry specialization and change in the study regions. Even though the sampling of the firms was not carried according to regional industrial strengths, knowing general characteristics and industrial specialization in the regions provided an understanding of the regional context during the data collection and interpretation phases.

In this phase, the sample universe of innovative firms was also acquired from the Scientific and Technical Research Council of Turkey (TUBITAK), and Technology Development Foundation of Turkey (TTGV). This sample consisted of Turkish manufacturing firms conducting R&D and receiving support services from the government or government supported entities. The receipt of public R&D funding was used as an indication that the firms were involved in innovation or technology upgrading because these funds are awarded by institutions through a competitive award process. The granting agencies typically appoint a board of university professors to monitor and scrutinize progress of supported R&D projects. Considering the scope and available resources, the study focused on firms that were actively engaged in innovation and upgrading and successful participation in publically supported award programs was seen as a reasonable indicator of a firm's active commitment to technological improvement and innovation. Given the scope and limitations of this study, examining firms actively involved in innovation activities offered a better chance to address the key questions in a more meaningful way. In this first phase, previously prepared surveys were also applied to three pilot firms located in Ankara, based on the outcomes of which the surveys used underwent several rounds of revisions. Approximately two months (February-March 2006) was allocated to accomplish the stated objectives in the first phase of the field work research.

Phase Two: Conducting In-depth Interviews and Surveys in Istanbul, Izmir and Ankara

The primary objectives of the second phase of the study were to conduct in-depth interviews with officials of various public and private institutions most directly involved in shaping the science, technology and innovation infrastructure of the country, and to conduct in-person interviews with innovative firms in the manufacturing industry to investigate specific regional and national factors that influenced the performance and innovative activities of the surveyed firms.

The first step in the field work was devoted to in-depth interviews with the officials of the institutions, mostly the central government ones, located in Ankara. Several in-depth interviews conducted with the officials of the TUBITAK and TTGV resulted in them providing data and support which greatly enhanced my ability to understand policies and programs and select firms that had received competitive support from government programs. In the following three months the in-depth interviews with firms and local support institutions were carried out in each region. These in-depth interviews were with representatives of universities, public research institutions and the selected firms in each of the three study regions (April-July 2006).

Phase Three: Follow-up Interviews with Science and Technology Policy Makers and Officials

Considering fast pace of developments in science, technology and innovation related policies in the year when the research was conducted, a second follow up round of interviews with the policy makers and officials influencing the direction of these developments was carried out a year later. A small but influential group of the original interviewees were contacted for a second round of in-depth interviews in July 2007. Some of the same questions were asked to understand if responses or perceptions had changed and the rest of the interviews focused on on-going changes and their repercussions on existing sets of policies and institutions. Documentation of new developments including new policy documents and reviews were collected and examined to better grasp how policy changes were responding to gaps or needs in the ongoing national innovation system building processes in Turkey.

3.3 Research Methods and Instruments

As noted, this study adopted a mixed methodological approach since both quantitative and qualitative assessments are needed to explain the factors that influence the decisions and abilities of firms to organize their business strategies around technology upgrading and innovation. A quantitative approach was required to examine characteristics and patterns of innovative activities of large number of firms and their interactions with other actors in the system. A qualitative approach was needed to understand local and non-local linkages and relationships and the character and significance of these relationships to the innovative activities of resident firms. Firms, as the major end users of public resources and services, were interviewed in-depth in a face-to-face setting to allow for clarification of terms and questions and to better delineate the importance and spatial of characteristics of extra-firm relationships. In some cases it would be impossible to extract or meaningfully interpret responses to many queries through structured postal surveys. In addition, examination of policy making around the new NIS building strategy at the national level was facilitated through in-depth questioning of on-duty and retired policy makers who were directly involved in policy making process. In sum, case study, survey and in-depth interview methods were utilized and combined to answer the main research questions of this study.

To investigate the status and importance of the national and regional levels of national innovation system building process in Turkey, four "cases" were developed. At the national scale, national innovation system studies require by definition an investigation of national level goals and policy making processes. Turkey provides an appropriate context for assessing emerging innovation system features because the country is a middle-income developing country with certain innovation system characteristics, which are neither fully developed nor highly limited or fragmented. The long science and technology policy and plan making history of the country makes Turkey an illuminating case because the innovation system building idea rests on evolutionary premises and benefits from existence of a certain set of pre-existing factors that facilitate formation of new institutions and relationships. In addition, Turkey is a centralized nation state where all regions are subject to the same regulatory, institutional and macroeconomic framework. The national environment, therefore, provides a critical context to assess the relative importance of regional competences and networks during a system building phase.

It is important to recall from the literature that policies and institutions are not the only means or resources that constitute innovation systems at the national level. It is the interactions, collaborations and resulting ongoing relationships that determine the essence and structure of newly forming innovation systems. The novelty of this research rests on the investigation of both the institutional framework and the importance and evolution of interrelationship between institutions and actors in assessing the performance of the NIS in the context of a middle income developing nation. Regions, in this respect represent a crucial component of the analysis because the importance of regional agglomeration economies and local interrelationships are seen as major factors influencing technological change and innovation. The issue is how the regional character of innovative processes highlighted in the literature pertains to a case like Turkey at an intermediate level of technological capacity and with a long history central government direction in technology and industrial policy.

3.3.1 The Case Study Regions

The definition of region in the literature is pretty ambiguous, as there is no single definition that captures all dimensions of the concept. A region, especially within the context of the regional innovation systems, might indicate a scale that is above the nation states, embracing territories of multiple nations such as the territory of the European Union, or it might be a district within a city that is functionally different than its surrounding area. Independent from the level of scale, there have been two approaches to 'defining a region' that differentiate the "region" from all other dimensions by tying it to a developmental perspective. In the words of McDougal et.al (1947):

> "Some define it [the region] as an organism of component parts, so interacting that the whole is different from the sum of the total parts. Others define it as an area, determined by a variety of natural and man-made indices, which is convenient for planning and administration for specified purposes. On close analysis, the difference between these two modes dissolves largely into a matter of words. The one has to define its components, and the other its "indices" in terms of relatively precise areal characteristics.
>
> Both require a group of people with certain homogenous attitudes, desires and wants; a contagious area with certain geographic unities; a certain base in natural and man-made resources, technology and economic institutions; and appropriate political and administrative organization. Both agree that the boundaries of a region cannot be precisely and permanently marked, that its extent depends upon variables that are constantly changing and that it is more important to identify core and approximate area than it is to dispute about periphery. In such a framework of fundamental agreement, the question of whether the whole is something more than the total of its parts is largely metaphysical. The important question is which style of definition gives to the people of an area the more effective vision of its possibilities of development. It is believed that a combination of both styles may best serve this purpose."

This holistic perspective of the region, informed the identification of the regions to be included in the study and the designation of their boundaries which appeared to be significant for the selection firms engaged in innovative activities. The Istanbul, Izmir and Ankara metropolitan regions appeared as the most expletory cases to explore the main research questions in this work. These are the three biggest metro areas in the country and they house almost all of the prominent institutions engaged in technological improvement and innovation. It should be restated that this study intends to use the regional innovation system concept as an instrument to evaluate the status of NIS construction in Turkey. In this respect, the cases at the regional level are not selected because they represent some distinctive types of relatively autonomous regional innovation systems as exemplified in the literature. These regions are selected since they are inherently part of a centralized administrative structure yet significant and distinct enough (in terms of industrial variety, intensity of knowledge and technology, agglomeration processes, etc) to evaluate national dynamics in terms of regional processes. Even though the boundaries of these areas are changing and are not known in terms of cultural distinctiveness or other attributes, metropolitan areas were used to select the study firms. However, in addition to following provincial boundaries for metropolitan areas, two additions have been made with the inclusion of Gebze district of Kocaeli and also the city of Manisa in the hinterland of Izmir, as they were informative in terms of assessing the sources and intensity of regional and national innovation linkages[24].

Istanbul

The case studies were chosen on the basis of their intensity and complexity of economic and institutional characteristics. Commonly defined as the primary city of Turkey, Istanbul is the largest province of Turkey with a population of almost 13 million inhabitants. It is included in the study as it has always been the center of Turkey's economic life and located at the juncture of major international trade routes. Istanbul's population accounts for 17.7 % of the total population in Turkey. In terms of population density, Istanbul ranks first with 2,389 people per square km, more than 26 times of the national average of 91.

According to 2001 figures, Istanbul ranks 7th in Turkey with $3,063 per capita income, which is 42.7 % higher than the national average of $2,146[25]. The city "produces almost 27% of national GDP, 38% of total industrial output and more than 50% of

[24] Gebze, located on the eastern border of Istanbul, is administratively part of Kocaeli, but highly integrated into Istanbul functionally. Gebze houses various big, industrial and innovative firms; the biggest public research institute (TUBITAK MAM) in the country and also the prestigious Gebze High Technology Institute. Manisa, on the other hand, is evaluated together with Izmir because many firms previously located in Izmir moved to the organized industrial zone in Manisa which houses and encourages attraction of technologically advanced, national and international firms. Firms in this organized industrial zone utilize urbanization and also the localization economies such as port and universities of Izmir. In both cases, it is pretty common for the skilled workforce to work in Gebze or Manisa but to live in Istanbul or Izmir respectively.

[25] As the latest regional data provided by Turkish Statistical Institute is for 2001, these figures are used in the text.

services, and generates 40% of national tax revenues"[26]. It is also responsible for 55.3 % of total exports, and 57.9 % of total imports in Turkey. The unemployment rate in 2001 which is 11.2 % is slightly over the national rate of 11.0 %.

As the industrial and financial centre of the country, Istanbul has experienced huge inflows of migration from other parts of the country since the 1950s which created incredible stress on the physical and economic structure of the city. Economically, it spurred informal sector of the economy, which makes up approximately one third of the city's working labor force, as economic growth was insufficient to provide jobs in the formal sector for all the new comers to the city. Istanbul employs 27.7 % of the manufacturing workforce in the country, even though the economic structure of the city has shifted towards a higher value added and service oriented industries especially after the 1980s. Many manufacturing establishments have left the city and relocated in Istanbul's larger functional area leaving the city with 126,393 manufacturing firms constituting 31.4 % of all manufacturing firms in the country. Manufacturing firms are concentrated in food processing, textile, oil products, chemicals, pharmaceuticals, electronics, glass, machinery, automotive and other transport vehicles, paper and paper products, rubber, metal ware and leather production.

The intensity of economic activities in Istanbul results in a large set of extra-firm institutions in the city. Industrial organizations, financial institutions, business associations, labor unions have a strong presence and are actively involved in city's politics. Many national public institutions and non-governmental organizations also have regional offices in the city even though they are headquartered in the capital city of Ankara. Some of the very best technical universities in Turkey are also located in

[26] OECD (2008). Accessed at: http://www.oecd.org/dataoecd/1/62/40317916.pdf

Istanbul. There are 30 universities in total of which 7 are public and 23 are private, and they make almost 20 % of all universities in Turkey. The total number of faculty including instructors and research assistants in universities in Istanbul also constitute 20 % of all faculties in the country. The biggest public research institute in Turkey, TUBITAK Marmara Research Center, is also located in the greater functional economic area of Istanbul together with other public research institutions.

Izmir

Izmir, the third biggest city in Turkey, is located on the western coast of the country with a population of 3,795,978, which accounts for 5.3% of the total population in Turkey. In terms of population density, with 316 people per square km, more than triple the national average of 91, Izmir ranks third in the country. Migration, though not severe as in the case of Istanbul, is an important factor that determines the composite of the city and also explains the rate of population increase (15‰), despite a declining birth rate, which exceeds Turkey's average (13.1‰) by 1.9 ‰.

According to 2001 figures, Izmir ranks 6th among Turkish metro regions with $3,125 per capita income, which is 45.6 % higher than the national average of $2,146. The city generates 7.5% of national GDP, 9 % of total industrial output and 10% of tax revenues. Izmir is responsible for 6% of total exports, and 4.1% of total imports in Turkey. 1,171,000 people are employed in Izmir and while 61% of the employed population work in the services; 31.5 % work in the manufacturing and 7.5 % work in the agriculture sectors. The unemployment rate is 11.8 % compared to the national rate of 11.0 % in 2001.

Izmir's 28,718 manufacturing establishments make up 7.1 % of all manufacturing firms in Turkey and 14 % of all establishments in Izmir. Manufacturing firms in various sectors are mostly located in two free trade zones and 18 organized industrial areas in Izmir. Agricultural products, especially cotton, figs, grapes, tobacco, olives and olive oil; foodstuff; textiles and apparel; iron and steel are Izmir's traditional exports. Electronics, automotive, ceramics, chemicals and paper products, and beverages are starting to replace the traditional export sectors in terms of trade volume.

Izmir also hosts numerous chambers and business associations such as Izmir Chamber of Commerce, Aegean Region Chamber of Industry, Aegean Free Trade Zone (ESBAS), and Aegean Region Association of Industrialist Businessman (ESIAD) which play important role in promoting Izmir as a favorable investment location, especially to foreign investors. The City promotes its natural port and well-connected hinterland, educated workforce and human capital, culture, climate and touristic surroundings.

Izmir is widely known for high levels of educational attainment and skill in its workforce, trained in either one of the seven local universities (which makes almost 5 % of all universities in Turkey) or in national universities in other regions. Out of seven universities in the metro area, 3 of them are state universities while the rest are private universities and 7.7% of all university faculties in Turkey, including instructors and research assistants, are employed in Izmir universities. Vocational schools associated with universities also supply many sectors with skilled labor.

Ankara

Ankara, the second biggest city and the capital of Turkey, has a population of 4,548,939, which accounts for 6.3 % of the total population in Turkey. In terms of population density, with 179 people per square km, the city doubles the national average of 91 and ranks ninth in the country. Ankara's population increase rate is 18.2‰ in comparison to Turkey's average increase of 13.1‰ per year.

According to 2001 figures, Ankara ranks 9th in Turkey with $2,752 per capita income, which is 2.8 % higher than the national average of $2,146. The city generates 6% of national GDP, 13% of total industrial output and 12% of tax revenues. Ankara is responsible for 3.9% of total exports, and 9.8% of total imports in Turkey. Manufacturing exports and imports make up 3.8% and 4.7 % of all manufacturing exports and imports in Turkey respectively.

Ankara employs 1,352,000 people and in terms of the employment composition, 72.4% of the employed workforce is in the services sector while 25.6% and 2% are in the manufacturing and agriculture sectors respectively. University graduates constitute 14.8% of the employed workforce in the city. The unemployment rate is equal to the national unemployment rate of 11.0 %. 6.3 % of all manufacturing firms in Turkey are located in Ankara, mostly in the Sincan, Akyurt, Cubuk, Ivedik and Ostim industrial areas. Manufacturing firms are mainly involved in machinery and metal ware, food processing, transport vehicles, furniture and textile production. Software and electronics are also among the most important sectors due to the strong presence of defense industry in Ankara.

There are 10 universities in Ankara which represent almost 7 % of all universities in Turkey. Two universities in Ankara, one public state university and one private university are nationally and internationally prominent in science and engineering fields and actively participate in various industry projects, mainly in defense-related sectors. These universities also have research institutes which lead the field in their specialized areas. The total number of faculty including instructors and research assistants in universities in Ankara constitute 20 % of all faculties in the country. The quality, size and structure of the Ankara universities and their close ties with the defense industry, fueled the establishment of nation’s first science and technology parks under a university partnership.

As the capital city, Ankara also hosts major public institutions including ministries and public research institutes. The local presence of TUBITAK (Scientific and Technical Research Council of Turkey), DPT (State Planning Organization), TTGV (Technology Development Foundation of Turkey), KOSGEB (Small and Medium Industry Development Organization) and TPE (Turkish Patent Institute) is especially important as they influence development of technology and innovation policies across the nation.

3.3.2 Public and Private Informants

As it has been touched upon at the field work chronology section of this chapter, this research mainly investigated two major realms of the NIS framework, the public organizations that support technological change and innovation and the private companies that actually produce innovations. This section will articulate how the specific public sector and firm informants were identified and the question and interview frameworks that were used to better understand the NIS construction process.

3.3.2.1 Institutions that form the NIS Framework in Turkey

The institutions that constitute the emerging innovation system in Turkey resemble in many ways international counterparts in OECD countries. The institutional composition of the emerging NIS began to be filled out and connected in the late 1990s, through adoption of more deliberate policies and systemic efforts to increase the pace of technological improvement to catch-up with the current technological developments in international markets, particularly the European Union. New institutional components were put in place to fill gaps identified through analysis and study of technology policies and institutions in advanced market economies. Now that the system in Turkey includes most of major elements found in OECD countries. However, a central question in this research is how the elements are functioning, particularly if significant and productive linkages and associations are developing between NIS components. Even though most of these system elements have a strong institutional history and heritage and qualified

Table 3.1 Key Institutions in Turkish NIS Development

Field of Organization	**Name of Organization**	**Type of Organization**	**Subordinate of**
Policy Making	Supreme Council of Science and Technology (BTYK)		Prime Minister
	Scientific and Research Council of Turkey (TEYDEB-TUBITAK)	Public	Prime Minister
	State Planning Organization (DPT)	Public	Prime Minister
Financing	Scientific and Research Council of Turkey (TUBITAK)	Public	Prime Minister
	Under-Secretariat of Foreign Trade (DTM)	Public	Prime Minister
	Under-Secretariat of Treasury (HM)	Public	Prime Minister
	Ministry of Finance (MB)	Public	Prime Minister
	Ministry of Industry and Trade (STB)	Public	Prime Minister
	Small and Medium Industry Development Organization (KOSGEB)	Public	Ministry of Industry and Trade
	Technology Development Foundation of Turkey (TTGV)	Non-Profit	
	Venture Companies	Private	
Business and Entrepreneurship Development/ Support	KOSGEB Technology Development Centers (TEKMERs)	Public	Ministry of Industry and Trade
	KOSGEB Entrepreneurship Development Center	Public	Ministry of Industry and Trade
	Technoparks	Public and Private	

	Turkish Standards Institute (TSE)	Public	Ministry of Industry and Trade
	National Metrology Institute (UME)	Public	Ministry of Industry and Trade
Knowledge Institutes	Universities	Public and Private	Higher Education Council (YOK)
	University Research Centers	Public and Private	
	University-Industry Joint Research Centers	Public and Private	
	Public Research Institutes	Public	
	TUBITAK Research Centers	Public	TUBITAK
Intellectual Property	Turkish Patent Institute	Public	Ministry of Industry and Trade
	Patent Consultancy Firms	Private	

personnel, the institutional cultures, inherited roles, and status in the central state bureaucracy make new forms of collaboration challenging.

It seems that, especially when the broad definition of national innovation system framework is adopted to test for systemic interactions, that some institutions will have a prominent leadership role (often attached to funding resources) while others will have a more subsidiary or symbolic role. While many institutions are nominally involved in technology development and innovation generation practices, particular institutions are specifically important in the establishment and functioning of the national innovation system. In the Turkish case, following institutions have important roles in fashioning and maintaining the functioning of the national innovation system.

3.3.2.2 Identification of NIS Support Organizations and Interviewees

Even as the institutions forming the national innovation system in Turkey were delineated, identifying key people in the institutions guiding technology policy and innovation was a challenge at the beginning of the field research. Three major lists of potential interviewees were prepared based on different data bases. First, major plans and policy documents were examined and the people involved in the preparation of key documents or participating in workshops and meetings that led to preparation of documents such as the technology foresight document Vision 2023 were identified. Repeating names in most of the documents were noted in addition to the names of leaders holding offices during the formation of more recent NIS strategies and initiatives. Second, major media resources including newspapers, technology and innovation policy related journals, magazines and web pages were identified and examined not only for knowledge of the policy making process and institutional framework specific to Turkish context, but also to validate and expand the list of potential contacts. Third, academics actively working on technology development and innovation issues were contacted to discuss their research and their perception of national policy directions and to find further sources from their own sets of networks. Names that were prominent in all three lists were identified as interviewees to contact and newer names, if missing, were added at the end of each interview as part of an adopted snow balling technique. During the first phase of the field research, government, industry and university contacts and interviews included: Turkish Science and Technology Council (TUBITAK); Technology Development Foundation of Turkey (TTGV); State Planning Organization (DPT); Ministry of Industry and Trade; Under secretariat of the Prime Ministry for Foreign Trade (DTM); Small and Medium Industry Development Organization (KOSGEB); ODTU Technology Development Center (ODTU TEKMER); Hacettepe University Technology Development Center (Hacettepe TEKMER); Ankara University Technology Development Center (Ankara TEKMER); Ankara Innovation Relay Center (IRC); Izmir Innovation Relay Center (IRC); Ankara Chamber of Industry (ASO); Istanbul Chamber of Industry (ISO); Aegean Region Chamber of Industry (EBSO); Aegean Free Zone (ESBAS); TUBITAK Marmara Research Center (TUBITAK-MAM); Interdisciplinary

Research and Application Center of Middle East Technical University (ODTU-BILTIR); Istanbul Technical University Automotive Technology Development Center (OTAM); Istanbul Technical University Metallurgical and Materials Engineering Department-Surface Technologies Group-; Bilkent University Nano Technology Research Center (NANOTAM); and TUBITAK Defense Industries Research and Development Institute (TUBITAK-SAGE).

3.3.2.3 Description of Interviews: List of Sample Questions

The interviews conducted with the representatives of supporting actors in the above NIS institutions (including universities, public research institutions, technology development centers, university commercialization centers, public institutions, etc) combined structured and open-ended questions due to the complex and multidimensional nature of the scope of the study. Accordingly, not all questions were used in every interview, but the same sets of questions were asked to multiple interviewees affiliated with the same institutions (in an attempt to improve the reliability and validity of interpretations of institutional positions and perceptions). It should also be noted that innovation policy was a hot topic in Turkey when the field research was conducted during the March-August 2006. Many developments were taking place in both the legal and institutional arena that necessitated another round of interviews with decision and policy makers at key institutions in the summer of the 2007. Additional questions were used during the second phase of the study to test initial findings and investigate changes and accomplishments since conducting of the first set of interviews. The following questions were directed to the interviewees in various organizations and in each interview the respondents were allowed to expand upon their answers of add additional points or elaborations to the questions in the interview frame.

Table 3.2 List of Interview Questions

1. How would you define a national innovation system? What is your definition?
2. How would you describe evolution of the Turkish National Innovation System?
   2.1. Since 1997, when BTYK explicitly called for the establishment of a national innovation system, what would you say have been the greatest changes influencing construction of the Turkish National Innovation System?
      2.1.1. Have there been changes in existing institutional structure?
      2.1.2. Have there been changes in existing legal framework?
      2.1.3. Have there been changes in existing financing mechanisms?
   2.2. How would you define the roles of your organization in the NIS building process? How important was/is your organization?
   2.3. How would you define your organization's relationship with other actors in the system?
   2.4. How successful would you define the overall system building process?
   2.5. What would you say are the major missing elements in the system?
   2.6. What would you say are the most successful policies and or measures in the system building process?
3. What would you say are the strengths and weaknesses of the Turkish National Innovation System?
4. How would you envision the future of the Turkish National Innovation System? Why would you say that?
5. How would you define the major obstacles in NIS development?
6. How would you define a regional innovation system in Turkey? What would you say are the key components?
7. Is it possible to talk about existence of a regional innovation system in your region? Why? Why not?
8. How would you place your organization in this regional innovation system framework? What specific roles does your organization carry out at the regional level?
9. How would you define relative positions of regional and national innovation systems in the country? Are they horizontal or hierarchical? How should it be?
10. How could co-operative relationships between institutions be improved for future systematic innovation?
11. What would be the main barriers to the improvement of these co-operative relationships?

Most of the interviews were taped after getting the consent of the respondents. Individual respondents were assured of anonymity by this author on any written document produced as a research output, but the identity of the institution could be revealed. Interviews typically lasted about 1-1.5 hours on average. Twenty-five in-depth, face-to-face interviews were conducted with national policy makers, policy analysts, technology consultants, representatives of the technology development centers, innovation relay centers, industrial associations and technopark managers by August 2006 (and 3 additional in person interviews were carried out during August 2007). Besides, 8 in-depth, face-to face interviews were conducted with academicians in universities and research centers by the end of the July 2006.

3.3.2.4 The Firm Interview Process

The scope and extent of this study necessitated in depth, face-to-face surveys to identify interactive nature of firms' relationships with other firms and extra-firm institutions and the significance of those relationships to the firm's efforts to upgrade their technology and carry out more distinct product and process innovation. During survey preparation phase, goals of this part of the study were identified to structure questions that got at the various national and regional dimensions of firm and institutional interactions. As innovations are in some sense related to both micro (firm) and meso (regional) level outputs the questions to investigate multifaceted dimensions of innovation drew upon various approaches that have been developed in the field of innovation surveys[27] (UNU-INTECH, 2004).

[27] According to Unu-Intech 2004, the evolution of innovation surveys shows that studies have mainly adopted three basic approaches to evaluate the innovation performance of firms. The first approach adopted to evaluate firm and larger level (region or nation) innovation performance was the 'output approach' which basically used number of patents and R&D expenditures as proxies for innovative activity. Within this tradition, the studies focus on learning about the characteristics of firms, sources of innovations, nature of innovations (product or process), costs of innovations, impacts of innovations on firm performances, the time lag between inventions and innovations and the diffusion of innovations (Myrtal et. al 1967; Edwards and Gordon 1984). The second, the 'activity approach', extended the focus of attention from R&D inputs to non-R&D inputs including design capacities, prototype development and competencies in identifying and testing new innovations in the market. In this approach, the definition of innovation is broadened and R&D is no-longer accepted as the primary source of significant innovations (European Community Innovation Survey, 1992). The third innovation systems approach, extended the objects of analysis a step further to include not only the firm level factors stimulating innovations, but also the extra firm factors at larger scales that burnished the resources available for generation of new knowledge at the firm level. Innovation systems surveys especially focused on measuring connectivity among the regional and national elements of the broader system.

In the survey preparation phase of the study, major innovation surveys, including the OECD's Oslo Manual were reviewed and used to identify central factors thought to influence issues of technological change and innovation in private firms. In the final survey design questions derived from the innovation systems approach were extensively used, revised and modified especially the queries adopted in the studies of Cooke 2002, Doloreux 2002, UNU-INTECH 2004, Ronde and Hussler 2005 to extract the knowledge required to answer the main research questions.

The fundamental goal of the firm survey portion of the study was to come up with an assessment of contemporary NIS policies in Turkey that were designed and implemented to promote linkages, collaborations and networks among different actors of the national innovation system. That objective required an understanding of firm characteristics and competences, resources and barriers to knowledge generation, types of collaborators and geographical location of collaborations and their strengths. The nature and scope of collaborations revealed in the surveys illuminated not only the extent and importance of regional factors but also the significance of national resources in generation of new knowledge and technologies. The surveys also sought to delineate the relative importance and intertwined nature of two different realms (regional and national) and their specific significance for the upgrading innovative efforts of the firms.

In this context, the goals of the firm survey portion of the study were as follows:

1. To explore the characteristics of innovative manufacturing firms in terms of the types of goods produced, firm age, geographic history, firm origin, R&D and related activities, firm size (employment and revenues), and geographic distribution of sales revenues.

2. To explore the specific technology and innovative activities of manufacturing in terms of novelty of innovations, types of innovations (product or process), reasons for

investing in technology or product and process innovations, competences of firms in carrying out innovations (organizational, technical, collaborative, and financial competences), R&D activities, patents, obstacles and/or hindrances in innovative activities, and identifying the importance of various knowledge sources for innovations, and understanding the impact of specific government support programs from the perspective of participating firms.

3. To explore the significance of proximity within the context of classic urbanization and localization economies.

4. To identify importance of location specific resources, types of collaborations, motives for collaborations and problems associated with local or non-local collaborations in innovation efforts.

Beyond understanding character and history, a principal aim was to explore, in-depth, particular factors supporting innovation generation at firm level. How do they value innovation generation, how do they see the process, do they believe they are singular actors or part of bigger networks? If so how do they describe the operation and importance of network relationships? Are these relationships mostly with other firms or institutions in a metro region or outside the region? Which national means and tools do firms employ to improve on their manufacturing and design capabilities? Which particular knowledge sources do they value most in their innovation efforts? Are these knowledge resources regional, national or international? What firm specific competences foster new product development? How do they assess the strengths of these competences? What are the major obstacles and hindrances with respect to innovation activities and how significant are they? How important, helpful and effective are government support programs for their innovation practices? In order to answer all these context dependent questions face-to-face surveys were carried out at the micro level.

The survey included several close-ended questions exploring the reasons for conductive innovative activities, the importance of knowledge sources for innovation; organizational competences; obstacles and hindrances for innovative activities; government support; the importance of innovation partners in providing technical expertise in different regions; the importance of different types of collaborations with other firms in different regions; the importance of different types of motives for carrying out collaborative activities with various institutions; the importance of specific types of collaborations with particular institutions in different regions; the importance of physical proximity to other institutions; and the importance of regional factors for the success of the firms[28].

For most of these questions, respondents' subjective ratings were measured through a close ended, 4-point Likert scales, anchored and labeled by two extremes either: "Very Important" – "Not Important" or "Very Significant" – "Not Significant". The ratings of respondents' regional and national embeddedness of firms in innovation efforts according to their sources of innovation though similarly measured via a close ended, 4-point Likert scales, anchored and labeled by: "Low" and "High". The Likert scale questions were adopted after the first version of the survey was pre-tested in Ankara in three manufacturing firms. Initially, firm level collaborations and their strengths were intended to be measured via asking the frequency of interactions with other institutions. However, these questions did not work in any of the pre-test companies as the respondents were not sure about the precise number of interactions carried out by other parties in the firms. Likert scale responses were used to measure the respondent's perceptions of innovative activities and relationships, both local and non-local. These

[28] The survey is available at Appendix A.

responses made it possible to differentiate the strength of various knowledge sources and also the collaborators in different scales within the context of new product development efforts. The vast majority of interviewees at the firms were either R&D managers or R&D project team leaders and they were competent enough to make comparisons among different sources.

3.3.2.5 Identification of Firms to Study: The Sample Selection and Survey Implementation

The list of firms to be surveyed was compiled from the TUBITAK-TEYDEB's and TTGV's databases of firms receiving government/public support for their technological product development projects. These databases were preferred to identify firms engaged in innovative activities because they were involved in projects that had already been evaluated by a technical board of academic referees and deemed worthy for innovation grants. This seemed to be a viable technique to identify firms active in innovation from the universe of all manufacturing firms. The database included the names of the firms, names of contact person (only in TTGV database), contact information of the firms including physical address of the firms, phone and e-mail of the contact person, the size of the firms, and the number of projects in each firm supported by TTGV and TUBITAK-TEYDEB programs and funding. The TTGV database was used as a secondary source to complement the TUBITAK-TEYDEB database to identify the firms that were not receiving government support.

When the database was retrieved in 2006, there were 1,153 total firms receiving some kind of innovation grant from the government. The database revealed that 572 of 1153 firms (49.61 %) were located in the Istanbul and Kocaeli region, 236 of them were located in Ankara (20.47 %) and 150 of them were located in Izmir and Manisa (13.01 %). The rest of the firms, 195 of them (16.91 %), were located in other cities all over the country. Considering that there are 81 provinces in Turkey, government support to innovative firms underscore the strong concentration of activity in the three study regions. However, this was in no way an explicit regional innovation policy in Turkey. The high regional concentrations were associated with the presence of high numbers of firms located in all these cities with higher potentials to compete, export and also explore available funding.

Table 3.3 Number of Firms Receiving R&D Support from TEYDEB in March 2006

Provinces	Firms Receiving R&D Support	% of Total	R&D Support to SMEs	% of Total to SMEs	R&D Support to Large Firms	% of Total to Large Firms
Istanbul +Kocaeli	572	49.6	465	51.2	107	43.7
Ankara	236	20.5	196	21.6	40	16.3
Izmir+Manisa	150	13.0	121	13.3	29	11.8
Others	195	16.9	126	13.9	69	28.2
Total	1153	100.0	908	100.0	245	100.0

Most of the firms in smaller cities are simply not as well positioned to carry out new product or process development due to difficulties recruiting a skilled workforce, accessing sources of research and information and in drawing on local partners to advance their technology or products. They usually do not have the awareness, capability or workforce competencies to apply to the government support programs and follow the imposed requirements. In addition these firms often rely on their own financial support mechanisms, especially family ties to fund their operations, and have little experience securing outside funding of any sort.

Many of the above mentioned factors are also relevant for the majority of the firms in the study regions. The firms applying in government support programs are obviously not the only ones that work on new product developments. But they are the ones with the awareness of public programs the capability to understand and access these programs, and with a stronger emphasis on improving on their technical capabilities to expand their businesses. The adoption of the list of publicly supported firms to identify the study sample therefore makes sense as the selected firms are already a part of the emergent national and regional innovation systems via their efforts to innovate in collaboration with other institutions.

In terms of firm size the breakdown of the support received by firms (Table 3.3) shows that 78.8 % of those receiving support are small and medium sized firms, or firms with fewer than 150 employees. In Istanbul, the distribution shows that 81.3% of firms receiving support were small firms compared to 18.7 % to larger firms. In Ankara, while 83 % of the firms receiving government support are SMEs, it is 80.6 % in Izmir. Although the study regions show similar trends with the national average, the collection of all the other cities shows relatively higher R&D support rates for big firms 35.3 % of total supported firms in outside the study regions were large firms.

When we observe the number of projects (versus firms) the distribution is balanced more toward large firms, with 44 percent of total funded projects going to large firms. However, the share of support to big firm projects outside the core regions was also higher than average at 55.6 %. This suggests that in smaller cities with more limited agglomeration advantages large firms have higher potential, capabilities and resources relative to SMEs.

Table 3.4 Number of R&D Projects Supported by the Size of the Firms

Provinces	Supported R&D Projects- Big Firms	%	Supported R&D Projects- SMEs	%
Istanbul +Kocaeli	577	50.09	772	53.65
Ankara	195	16.93	308	21.40
Izmir+Manisa	151	13.11	176	12.23
Others	229	19.88	183	12.72
Share of Total	1152	100.00	1439	100.00

The majority of the government support to R&D goes to firms functioning in manufacturing industries. The manufacturing firms receiving government support in Istanbul/Kocaeli constitute 63 % of all firms (312 of 495). The percentage is 50.4 % (104 of 236) and 70.6 % (106 of 150) for Ankara; and Izmir/Manisa respectively. The low share of support going to manufacturing in Ankara is mostly due to the high presence of applications in software industry in which the city has a solid and growing share supported through its technical universities, technoparks and defense industry. The majority of firms receiving government support being in the manufacturing industry and also the focus of innovation systems literature on manufacturing industry made me exclude high-tech service firms and construct the sample among the manufacturing firms in the study.

To identify the firm sample, the selection criteria were reference to the manufacturing industry and operation at the establishment. Within these parameters, a randomly selected sample of 112 firms in Istanbul was established. For Izmir and Ankara, the total manufacturing list of 106 and 104 firms was used respectively. Table 3.5 exhibits the individual elements of the data collection process. First some of the firms were discarded because their contact information was not up-to-date and they could not be found out through other resources including the TTGV data base or a simple web search. A number of remaining firms explicitly refused to participate in the study as they did not deem the study relevant to their activities; they had a corporate policy of declining survey requests; they were unwilling to reveal their innovation processes to third parties; and they were survey fatigued. Another set of firms were impossible to reach out after several follow-up calls and e-mails. As a consequence the gross sample was reduced to 107 firms in Istanbul, 101 firms in Izmir and 93 firms in Ankara. From this sample, 28 Ankara firms declined to participate to the study; 39 firms were impossible to reach after several follow-ups and 26 firms participated in the study. The consequent response rate was 27.9 % of the population selected in Ankara. In Istanbul, only 5 firms declined to participate in the study; 72 were impossible to reach after several follow-ups and 28 firms participated in the survey[29]. In Izmir, 15 firms declined to participate in the study, 56 firms were impossible to reach and 29 firms participated in the study. The consequent response rates were 26.1 % and 28.7 % of the population selected in Istanbul and Izmir respectively[30].

[29] One of the respondents had to cancel the interview in the middle of the meeting due to an emergency in the production line. Another survey got cancelled due to the inability of the R&D manager to answer most of the questions regarding the competencies of the firm and the extent of its networks.

[30] Compared to the two other regions, concomitant with its bureaucratic culture rooted in being the capital city and homing to all sorts of public institutions, Ankara was the most strenuous one in terms of reaching out to firms and carrying out the survey as it could be seen through the high refusal rates to participate in the survey. The firms which were widely known in terms of their innovative and technology development activities, especially the ones receiving national technology development awards, etc., and stated as important to talked to by bureaucrats, academicians and consultants in various organizations were given extra effort to persuade them to participate in the study. At most two surveys were carried out in a day as surveys generally took one to two hours to implement depending on firms' range and extent of activities and location of the firms in four different parts of the city namely, Ostim, Sincan, Akyurt and Golbasi which are considerably distant from each other. In comparison to reach out experience in Ankara, firms in Istanbul were easier to persuade to participate but harder to schedule interviews due to vivid business culture in the city. Cancellations and rescheduling were frequent. Majority of the firms were located at the districts of Umraniye, Kartal, Ikitelli, Pendik, Tuzla, Sultanbeyli (and also Gebze). In Izmir majority of the sample firms were located at Cigli, Kemalpasa, Gaziemir (and also Manisa).

Table 3.5 Individual Elements of the Data Collection Process

	Istanbul	Izmir	Ankara
Total number of firms in the list	312	106	104
Randomly selected firms	112	106	104
Non-relevant firms (missing information on address, name, industry type, bankruptcy)	5	5	11
Re-adjusted sample	107	101	93
Unable to contact	72	56	39
Declined to respond	5	15	28
Interviewed firms	28	29	26
Response rate	26.1 %	28.7 %	27.9 %

In all three regions, 83 firms were successfully surveyed and they constituted 16 % of all the manufacturing firms that received government support for innovation. The adopted methodology is original in the sense that it brings two conceptual frameworks together to explain and evaluate the emergence of the NIS framework in the major economic regions of Turkey from the perspective of firms engaged in innovation. Through detailed interviews, the importance of regional agglomeration economies and specific regional ties and associations are also explored for the firms interviewed. Investigating the relative significance of national and regional associations related to innovation from the firm perspective allows greater insight into the status and potential importance of regional innovation networks in NIS policy making and performance. In particular, when contrasted with the history and national policy making record in the area of technology and innovation the interviews provide important evidence as to whether regional characteristic of innovation are appropriately addressed in national policies.

In the following chapter, historical records and literature are analyzed to understand the dominant role of the central government in Turkish economic and technological development. This background provides the context and institutional impetus behind the recent strategies organized under the NIS framework. In the next section of the dissertation, these recent efforts are analyzed from the perspective of key decision-makers and policy implementers in the key agencies of central government. These perspectives are evaluated against government reports, documents and legislation to understand the policy goals, program initiatives and funding levels associated with the recent NIS initiatives. A special emphasis was put on understanding how the role of regional specialization and agglomeration was viewed by national policy makers and how regional considerations shaped NIS building in recent years.

Chapter 4: Historical Overview of Turkish Industrial and Technological Development

The literature that draws upon the NIS framework emphasizes that the evolution of public and private institutions supporting technical change and innovation is shaped by the long- term social, political and economic development of nation states. The long term national development trajectory is influenced by geography, political culture and stability, and relative wealth and position vis-a-vis trade partners or rivals. These broader influences shape more specific national elements influencing industrialization and technological change including market rules and norms, property rights, government investment allocations and so on.

There are three recurring factors that have shaped industrial and technological development in Turkey over the very long term. First, is the historic geographic position of the nation, straddling Europe and Asia. This unique position has defined the trade relations, allies and rivalries, political structures and the models of economic development that have advanced or limited national development. Second, since the apogee of the Ottoman Empire in the 15th and 16th centuries, Turkey has persistently been faced with underdevelopment and "catch up" challenges in relation to its European neighbors. Third, the long-term historic pressures of first building and maintaining the empire in response to European development, and then to the establishment, restructuring and modernization of the new Republic have made the central state a dominant actor. The central state, as will be shown, has at times created frictions and fetters for the expansion and healthy development of the market economy, but at other times has built and pushed forward modernization and the conditions for market based development. These long term dynamics have played out in unique ways in the 20th century and in the contemporary period as Turkey attempts to integrate more fully with the EU and improve its economic performance by fostering a more endogenous process of technological improvement and innovation.

4. 1 History of Industrial Development

4.1.1 The Ottoman Period (1600-1922)

The Ottoman Empire through its long history was an agrarian based military state in which most of the population lived in the countryside and earned their livelihood from agriculture. The majority of the state revenue was based on the agrarian sector, the productivity of which was dependent on the competencies of local public officials who were in charge of the tenancy of state owned agricultural land. Public officials were responsible for collecting taxes on the agricultural produce and also the training of soldiers in their jurisdictions to support the central administration when military demands arose. In addition, the Empire controlled critical trade routes between Europe, Asia and the Mediterranean basin. But the agrarian system, which was called timar or dirlik, constituted the main structure of economic production and distribution until the Empire started to deteriorate at the end of the 16th century. The reasons for the demise of the Ottoman system were many, but most importantly the Empire encountered increasing barriers to new territorial acquisition and the rules and technologies necessary for intensification of agriculture were not in place. Hence activity and associated revenue for the state stagnated. Moreover, increasing wars and internal conflicts resulted in an increase in the amount of idle arable land severed from the economy. The chaotic atmosphere accentuated corruption in both in the central and local governments and led to ineffective timar management by more autonomous and often corrupt officials. (Kepenek and Yenturk 1999, Quataert 1993).

While the industrial and technological levels of the Empire in the 16th century were equal or superior to major European powers, the Ottoman social and governance structure was unable to sustain the development level through the enlightenment and subsequent industrial revolution. The indigenous manufacturing industry in the Empire was developed primarily to meet the demands of the military, especially in the conflict ridden 19th century. Civilian manufacturing was carried out by small scale production units which prioritized production of consumer goods such as textile and clothing, agricultural implements, and construction materials for the local domestic markets. The organization and regulation of manufacturing activities in urban settings was dominated by guilds dedicated to production of a specific type of good.

The guilds in Turkey were comprised of mostly ethnic minorities such as Jews, Greeks and Armenians who in the Empire were restricted from holding positions in the government. In the multiethnic Empire, professional segmentation did not generate major social problems for some time since the system functioned smoothly and the diverse needs of social groups were generally met. Capital and technological expertise was accumulated in the hands of minorities that dominated the memberships of industrial guilds. Membership was based on lineage and ethnicity according to the rules and norms established within the guilds.

> "Membership acquisition to the guild and guild collective behavior was achieved through a framework of rules, rituals and other group norms, partly unwritten yet officially recognized and partly laid down in official regulations and orders. The rules fostered a variety of monopolies and restrictive practices, and the rituals and other group norms created a sense of trust among guild members" (Riddle 2001:45).

The guild system prevailed until the late 1800s and the domestic manufacturing system provided non-agricultural goods to markets in the Empire. The influx of cheap European imports produced by technologies developed during the Industrial Revolution challenged the Ottoman manufacturing industry in general and the guild system in particular as the nineteenth century progressed (Kepenek and Yenturk 1999). In the early 19th century, there were some attempts to build a national industrial base in the Ottoman Empire to accomplish the Ottoman Industrial Revolution.

> “In the hopes of spurring on an Ottoman Industrial Revolution, Mahmut II [1808-1839] and his descendants established several large industrial projects, designed and operated by European and American manufacturing experts. Efforts to transform the ailing Ottoman economy through state-led production can best be described as too little, too late. An Ottoman industrial revolution failed to materialize, and as Empire resources lessened, state factory production was limited and in some cases abandoned” (Riddle 2001:48).

Later in the century, close connections with Germany reanimated the national industry formation ideas, but efforts remained ineffective and the necessary support mechanisms such as establishment of financing organizations and banks could not be developed due to rising national independence movements and fragmentation within the Empire (Kepenek and Yenturk 1999).

As the military defeats and territorial losses accumulated the tax revenues of the state continued to decline, the Ottoman Empire began to rely more on external debt to pay for imports. Meanwhile, the European powers attracted by the size of the Ottoman market forced the Empire to relax strict trade restrictions and allow special trade concessions in return for loans and grants. (Riddle 2001:47). These special considerations left the Ottoman manufacturing industry totally unprotected and domestic industry suffered against cheaper and better European goods produced under larger scale and more modern conditions. The concessions also included demolishing of the guild system in the Empire as guild monopolies were inconsistent with the core assumptions of the free trade agreements (Kepenek and Yenturk 1999:16). By the late 1800s, the guild system had totally collapsed under the pressure of new government policies and the influx of

European imports. An "ethnic division of labor" and the dominance of minorities and foreigners in industry and trade, on the other hand, continued to prevail until the early 1900s.

The legacy of the guild system and the decimation of domestic industry presented enormous challenges to the new Turkish Republic, founded in 1923 after the dismantling of the Ottoman Empire. First of all, ownership of existing manufacturing and trading companies by Armenian and Jewish minorities, slowed the impeded development of a broader entrepreneurial class that incorporated the ethnic Turkish majority. Turks were historically more engaged in agricultural activities and were detached from more modern urban manufacturing and trade that were at the heart of capitalist transformation (Bugra-Kavala 1994). In the long period of turmoil culminating in the fall of the empire, many minority owners and managers of industrial and trading companies left or fled the country. The loss of these groups due to pressure and chaos meant the loss of an accumulated knowledge base for a new industrialization drive in the Republic. Lack of experience in modern production methods and techniques appeared as a serious challenge for the new state that set industrialization and economic modernization as primary objectives for the new Turkish Republic.

4.1.2 The Early Republican Period (1923-1960)

4.1.2.1 Liberal Era (1923-1929)

In the beginning of the 20th century, the "sick man of Europe," the Ottoman Empire, was defeated in many battles including World War I. The economic and political system of the Empire was almost completely bankrupt and national sovereignty was in question. After defeat of the Central Powers the Allied forces controlled Turkey and the reigning Ottoman Sultan Abdulhamit was forced to sign the Treaty of Sevres in 1920, which officially accepted the end of the Empire. After signing the Sevres, Abdulhamit left the country and moved to London. His absence increased political discord and turmoil throughout the Turkey but also stirred burgeoning support to the national independence movement started by the General Mustafa Kemal (Ataturk).

The War of Independence (1920-1923) pitting the national independence movement against shifting alliances including Greeks, Armenians and other European forces ended with the reestablishment of a significant autonomous Turkish nation recognized in the Treaty of Lausanne in 1923. The Treaty acknowledged Anatolia and Istanbul as the new territory of the Turkish Republic. In economic terms, the biggest gain was the abolishment of the special concessions granted to European states during the Ottoman period. Special free-trade concessions were eliminated but low tariffs and restrictions against quotas remained valid until 1929 which forced the new Republic to follow more liberal economic policies.

The period between 1923 and 1929 can be defined as a reconstruction period. Government structures and institutions inherited from the Ottoman Empire were so decayed that renovation was indispensable under the ideals and aspirations of the new Republic. The chief economic objective of the new state was development of a strong private sector capable of achieving the industrialization objectives of the Republic that revolved around the desire to build a modern secular state comparable to European counterparts. As previously noted the period of turmoil left the nation without an entrepreneurial class and management expertise for modern industry. In this vacuum the Turkish government assumed the primary role in forcing economic modernization. This was an enormous challenge as the financial and human capital of the country was depleted during the long period of war and instability.

In a process broadly evocative of Gerschenkron's theory of state-led development in backward economies, the Republican government established a plan for modernization and industrialization at the Izmir Economics Congress in 1923. Tying a strong push for industrialization to the theme of economic independence, the Congress urged the establishment of financial institutions to provide loans and grants to domestic businesses; the improvement of basic infrastructure, most importantly rail transport and communication networks; and the formation of industrial training organizations. The government took measures that supported the suggestions of the Congress and first established the State Industry and Mining Bank (Sanayi ve Maadin Bankasi) in 1925 to provide loans and grants to private sector. The government also strove to increase public and private partnerships and to take a management role in state owned enterprises temporarily until they are passed on to private sector firms. Furthermore, the government enacted the Law for Stimulation of Industry (Sanayii Tesvik Yasasi) in 1927 which included exemptions from income and custom taxes, reduced fees and duties, the provision of free land, and telephone and telegraph services to businesses. The law also provided government support of up until 10 % of annual production and discount prices on the transportation of production technologies transferred from abroad (Kepenek and Yenturk 1999:44-45).

When the Law was enacted in 1927, the composition of the industry was dominated by the production of agricultural products. There were approximately 65,000 business enterprises, 43.5 % of which processed agricultural products, 23.9 % of which produced textile and related products and 22.6 % of which operated in the mining and machine production. The aggregate size of the enterprises was relatively small. The percentage of the businesses with more than 5 employees was 8.9 % of total enterprises, while business with more than 100 employees were only 0.23 percent of the total

(Kepenek and Yenturk 1999:45). The composition and capacity of the industry was not capable of meeting the demands of the internal market. Even though, textile was the second biggest sector, textile and apparel imports constituted 41.5 % of all imports into the country in 1927.

This period involved much trial and error and rebuilding from a state bureaucracy that had limited experience and capacity in more systematic economic development planning. One thing that was commonly agreed upon was the need to develop domestic consumer industries to reduce reliance on basic consumer goods imports. As part of this process the release of restrictions on tariffs in 1929 encouraged adoption of more direct import substitution policies. The Great Depression affecting the global economy and associated domestic problems in Turkey combined with the model of Bolshevik central planning brought about a paradigm change and toward a stronger "etatist" industrialization program in the 1930s and 1940s.

4.1.2.2 Etatism in Turkey: State Organized Industrialization (1930- 1949)

During the first seven years of the Republic, the government followed a relatively liberal economic policy that emphasized the development of financial mechanisms and capital access for private firms, revival of decaying state enterprises and some education and training of an industrial workforce. These development projects and the success of the nascent private sector depended on international funds and credits that dried up with the outbreak of the Great Depression (Ekiz and Somel 2005). The models of western capitalist economies that shaped the policies of the new Republic were in crisis. In these conditions the government had to reconsider external realities as it tried to adjust its internal economic policies. Meanwhile, Soviet Russia had started a fast and extensive industrialization process through the adoption of state directed central planning. The Turkish government, pressured by political discord associated with the economic crisis decided to follow a more state directed and centralized industrialization strategy to accomplish a more rapid drive to economic independence (Ekiz and Somel 2005). The etatism[31] which characterized almost 20 years of state led economic development in Turkey had its own peculiar characteristics. It incorporated certain state planning elements from the socialist model but did not include socialist rhetoric, mass expropriations of property or collectivization of agriculture. The political rhetoric was primarily nationalism and industrial modernization, not socialism.

However in the Etatist era, the state appeared as the dominant coordinator and driver of economic development. In order to nurture and protect domestic private industry, the state not only restricted entrance of foreign investors in to the country but also encouraged domestic production of inputs that used to be imported by the enterprises. To build up indigenous primary and capital goods sectors it established and operated SEEs (State Economic Enterprises) according to the suggestions of Five Year Development Plans in the textiles, iron and steel, mining, cement, chemicals and paper sectors. The first two five year development plans were put into place in the years of 1934 and 1938. Rather than being comprehensive development plans, both of these plans were more like targeted investment project bundles. The first plan prioritized development of consumer and producer goods industries while the second five year development plan emphasized investments in intermediate and primary goods (Ekiz and Somel 2005:104, Boratav 1976).

[31] Etatism (or statism) in economic realm asserts that states as major institutions have legitimate powers to direct and regulate the economy, either through state owned enterprises or through strategic economic development planning.

State Economic Enterprises grew to dominate manufacturing production with an objective of meeting domestic demand as in the case of “Sumerbank” in textile industry (Riddle 2001:52). Both state and private enterprises grew under an import-substitution manufacturing policy as the government instituted high tariffs on imports. State Economic Enterprises, equipped with imported state of the art technologies[32], fueled the economy by generating growth and stimulating structural change in the targeted sectors. For instance, by the end of 1930s, domestic textile production was capable of meeting almost 80 % of internal demand. And, cement production, as a result of the expropriation and restructuring of private enterprises and establishment of new factories increased by 15 fold (1,428 %) between 1927 and 1935.

Until the beginning of the World War II, Gross National Income (GNI) continuously increased[33]. This growth was strongly associated with the growth in manufacturing industry, which averaged a 9 % annual growth over this period (Kepenek and Yenturk 1999:78). Although Turkey was not a belligerent in WW-II, the massive disruption of the war years buffeted the Turkish economy and between 1939 and 1945, national income in industry decreased by 34 %. These war disruptions occurred in the context of the massive destruction of all European economies.

At the end of the war, Europe began a huge rebuilding and economic transformation process which influenced and changed production dynamics in countries on the European periphery. In response Turkey adopted an Urgent Plan (Ivedili Plan) in 1946 to cope with the changing needs of the post-war era. Pressured by the terms of

[32] According to Tekeli 2006, the main technology transfer policy of the time was getting technologies from different countries which have different technological trajectories. While textile production technology and know-how was primarily adopted from the Soviet Russia, sugar production technologies and know-how was acquired from the Western countries. The peculiar pragmatic nature of the Turkish Etatism revealed itself at these technology transfers.

[33] There was only a 2.4 % decrease in 1935 in national income in constant prices.

Marshall Plan during reconstruction phase of the Europe, the Urgent Plan had to be revised and was replaced by the Vaner Plan in 1947. The biggest difference between the Vaner Plan and the previous plans was a fundamental change of vision and focus for the further industrialization in the country. The drive for state directed heavy industrialization was replaced by an emphasis on private sector liberalization and agricultural and infrastructural development (Ekiz and Somel 2005: 106-108).

4.1.2.3 Rebirth of Liberal Policies: Development without State Planning (1950-1960)

The aftermath of WW II and associated international developments were the major determinants of change in the industrial policies of Turkey. However there were corresponding internal shifts that contributed to the collapse of etatism. Etatist policies were linked with the single party administration in Turkey in the Republican period. In 1950, a multiparty system was established and voters ascribing the war time economic hardship on the single party administration gave an electoral majority to the newly founded Democrat Party (DP). The followers of the new party were mostly peasants, big land owners and trading enterprises. The last of the two interests amplified their powers through capital accumulation associated with the specific economic opportunities of the War. As a result, the new government prioritized agricultural and infrastructural development to address the demands of its main constituency.

In addition, under the Marshal Plan framework Turkey assumed a critical role supplying consumer and primary goods, most importantly food, to Western Europe to overcome severe food shortages and to provide inputs to European industrial reconstruction. Endowed with this new role and operating under the more liberal framework of post war international economic agreements and institutions, the government started a new investment strategy focused on the encouragement and development of the private sector. The planning ideals and strong central government steering of the etatist era were left behind and more liberal, market based development of investment projects were promoted and mostly funded through foreign borrowing.

In order to increase the capabilities of the private sector, the government encouraged public-private partnerships in many sectors including, food, machinery and mining, textile and transportation (Cakmakci, 1999). State Economic Enterprises still played a major role in the production of capital and intermediate goods and were equipped with relative modern production technologies developed in the 1930s. The private sector grew more on the basis of consumer goods such as foods and textile. These partnerships and the opportunity to supply the rebuilding economies of Europe contributed to increases in the value added of manufacturing industry, despite the increased attention and investment poured into the development of agriculture at the time.

The more market based development of industry and prioritization of agriculture, which later lost its pace as the driving force of development, led to funding of investment projects through large scale external borrowing. Borrowing began to outpace the capacity of the production system to generate revenues, especially export revenues (Ekiz and Somel 2005:110). A huge external payments deficits crisis occurred in 1954 and it continued to deepen until the end of the decade. An urgent need was seen to develop more sophisticated fiscal policies tied to coherent mid and long term macro-economic policies (Ekiz and Somel 2005:110). The macro-economic and domestic investment policies that came out of the external debt crisis relied on foreign economists and the input of international economic institutions. These key factors shaped economic and industrial policies for the next 20 years.

4.1.3 Import Substitution Industrialization Period (1960- 1980)

The ruling Democrat Party's increased use of religion to hold the support of the agrarian masses. In addition, the development of policies challenging the republican reforms favoring the secular state heightened the tension between the ruling party and the opposition and resulted in the first military coup in 1960 in Turkey. The military government started a new institutionalization process, initiated with the preparation and adoption of a new constitution. The State Planning Organization (DPT) was established to set the principles of "development planning" in Turkey to guide development of the national economy around major industries. The macroeconomic framework was the then popular Keynesian economic growth model. Development planning, in this respect, was not just a bundle of investment and infrastructural projects but was tied to macroeconomic growth objectives. In 1960, the Turkish government introduced an import-substitution oriented development strategy which prevailed until the end of 1970s. The swing back to import substitution industrialization policies were mainly caused by high inflation rates and the balance of payments crisis in the 1950s. To overcome this payment crisis, the government adopted an industrial strategy to expand domestic growth through increasing domestic protection which would overcome the growth constraints stemming from negative payments balances. In this respect, the industrial strategy prioritized mobilizing available industrial capital through restricting international purchases and increasing domestic sales within a protected environment.

The five year development plans[34] of this period fostered the execution of big public investment programs to increase domestic capacity and capabilities in the manufacturing industry. State economic enterprises (SEE) continued to be supported to

[34] Five year development plans of State Planning Organization were "guiding" instead of "mandatory" documents.

produce capital and investment goods while foreign investors and the private sector were given incentives to produce consumer durable and non-durable goods. Import substitution industrialization strategies in the 1960s were dependent on the strength of the existing domestic market and thus were not as clearly transformative as the strategies adopted during the early years of the Republic (Ekiz and Somel 2005). Still, the most significant characteristics of the development plans were their prioritization of industrialization to achieve economic growth.

The First Five Year Development Plan (1963-1967) explicitly stated the need for protection of the domestic industry until it is mature enough to compete in international markets. Emphasis was put on the limited and presumably temporary character of industry protection while attaining the targeted industrial growth rates. In order to achieve the expected 7 percent aggregate annual growth in the economy, the targeted industrial growth rates were explicitly specified in the first two Five Year Development Plans. The manufacturing sector, with an estimated 12.9 % and 11.1 % growth rates respectively assumed the largest role in the growth strategy in these first two plans. Although, quantitative targets were stated, qualitative measures such as production technologies or business scale or organization associated with growth targets were not addressed in the Plans (Kepenek and Yenturk 1999:78).

The Third Five Year Development Plan (1973-1977) was qualitatively different from the first two plans. The biggest difference was the influence of relationships with then named European Economic Community (EEC), now the European Union (EU). Turkey had became an associate member of the EEC in 1963, and an adjustment period was seen as necessary before signing the customs union and full membership agreements. The adjustments required included substantially increasing the industrial and social development levels of the country. An additional protocol (Katma Protokol) signed in

1973 set a 1995 target date to accomplish the required socio-economic improvements to be full member of the Customs Union. Responding to the promise of fuller integration with Europe the Third Plan shifted away from the fast industrial growth objectives of the previous plans to something more qualitative involving socio-economic and cultural catch-up with industrialized Western nations (Kepenek and Yenturk 1999, Onis 1999).

On the one hand, the import substitution based development policies had significant success in achieving substantial growth and industrialization over a 20 year period. Industrial growth averaged 6% per annum between 1960 and 1980. However, the expected transformation in the economic structure to high levels of international competitiveness was not achieved during the import substitution period as the quality and pricing of the manufacturing goods did not reach the expected standards in international markets. This led at the end of the period to stagnant exports matched with increasing imports required for industrial production, particularly dependence on imported raw materials, especially energy and modern capital goods from the now more advanced OECD countries (Taymaz 2001, Kepenek and Yenturk 1999). The oil shocks of the 1970s added to these mounting pressures and deepened an ongoing economic crisis in the country.

4.1.4 Export-oriented Industrialization Period (1980-Present)

The second oil shock in 1979 forced economic planners to take some fundamental steps toward changing the inward oriented policies of the prior twenty years. On January 24, 1980, a new rightist government announced a reform (stabilization) program aimed at liberalizing trade and changing policies to promote exports. It emphasized reducing the state role in the economy, realistic exchange rates and monetary policies; and increased foreign direct investment. The January 24th Program, included not only reductions in import tariffs and quotas but also increases in several export promotion policies.

The government's export promotion policies included export tax rebates, production or value added tax exemptions on final goods, easily accessible export credits, exemptions from custom duties for production technologies or capital goods used in production of exports and conditional exemptions on corporate profit taxes. These policies initiated a dramatic shift toward a more export oriented economy. Turkey's export share of GDP rose from 3 % of GDP in 1979, to 20 % in 1996. (Riddle 2001:57, WB World Development Indicators). These export promoting policies were accompanied by currency devaluations, restricted domestic demand, increased capacity utilization rates and export credit subsidies. A qualitative change also took place in the composition of exports which shifted to manufacture of processed foods, textiles and motor vehicles. These dramatic increases in manufacturing exports were not triggered primarily through improvements in technology or manufacturing value added. Improved export performance was rooted in the full utilization of existing capacities, improved management of enterprises and more favorable wage and currency exchange rates vis-a-vis major trading partners.

The export promoting policies also stimulated emergence of a new group of private entrepreneurs in the Turkish economy who gained capacity and experience by entering into new domestic and international markets through promotion policies. These entrepreneurs were at the stage of selling low and middle tech goods at competitive prices in international markets, but they were not positioned to move up value chains through technology and knowledge based investments. In this period they were also not given incentives to upgrade technology and there were few extra-firm support mechanisms to upskill the workforce or foster technology building processes (Kepenek and Taymaz 1998).

The January 24th structural adjustment program and the subsequent developments during the 1980s achieved considerable success as it reduced external deficits and increased economic growth. The success was predicated on increased foreign direct investment, export promotion and privatization policies. Among all these conditions, privatization experiments were defining for the reorganization or reconstitution of the state, as the SEEs (State Economic Enterprises), despite their low performances and operating losses, accounted for more than 50 % of total fixed capital formation and 40 % of total value added in the manufacturing industry (Onis 1991:164). While the need for organizational reform to overcome inefficiencies was crucial, SEEs were the drivers of the manufacturing industry and

> "neither privatization, nor the liberalization of SEEs, involving their opening up to greater external competition, elicited widespread acceptance. They had been established in Kemal Ataturk's time, and constituted an important historical legacy. They had been part of a broader project of national reconstruction undertaken by bureaucratic elite with a clear mission to act as the "guardian of the national interest". That the state economic enterprises were considered to be part of the Kemalist era, constrained the possible transfer of ownership from the public to the private sector. The debates surrounding SEE reform and the orientation of policy reflected the strength of the traditional bureaucracy. This highly centralized bureaucracy and the associated state tradition undoubtedly influenced the course of public sector reform at that time" (Onis 1991:164-165).

The World Bank became actively involved in transformation of SEEs in Turkey between the years 1980 and 1984. Through its structural adjustment loan programs, the Bank aggressively but incrementally pushed forward public sector reform. First of all, it worked towards improving short term financial positions of the enterprises. Second, it redirected financing of investment programs out of government budget resources and third, changed the tasks imposed on SEEs to support private sector firms by providing subsidized intermediate goods (Onis 1991:165). The SEEs were reformed internally to operate more like private enterprises and to generate their own profits to support investment.

During the 1990s, the signing of the Customs Union Agreement with the European Union that was effective as of January 1996, influenced the competitive nature of not only the public but also [and most importantly] the private sector. Most enterprises in order to compete with the high-tech more efficient European producers in both domestic and international markets were forced to upgrade their production capabilities by investing on newer technologies. However, the objective of diversifying the export base through medium and high-tech products did not generate the expected transformation in the production structure. More forward looking and coherent industrial, trade and technology policies such as those implemented in other newly industrializing countries such as South Korea were not developed in Turkey. Efforts to increase export potential in European markets mostly relied on more traditional mechanisms including devaluations and export incentives that did not qualitatively improve the productive infrastructure (Rodrik, 1995). For instance, while the aggregate GDP's of the Turkish and South Korean economies were pretty close to each other at the early 1980s, the Korean economy grew to almost triple the size of the Turkish economy at the end of the 1990s. Consequently, real GDP per capita in South Korea increased 447.42 percent between 1980 and 2010 while Turkish per-capita GDP increased only 97.79 % since the 1980.

Table 4.1: GDP, current prices, (US Dollars, Billion) **

Countries	1980	1990	2000	2010*	Growth 80-90	Growth 90-00	Growth 00-10
Argentina	209.02	141.34	284.33	344.14	-11.18	51.22	44.92
Brazil	162.62	507.78	644.28	1,910.50	16.62	28.48	40.08
China	309.27	390.28	1,198.48	5,364.87	142.86	169.63	161.26
Denmark	69.71	135.84	160.08	313.83	22.81	29.22	6.58
France	691.23	1,248.56	1,333.38	2,668.79	27.07	21.64	13.07
Germany	826.14	1,547.03	1,905.80	3,332.80	25.53	22.73	5.94
Greece	53.64	92.20	127.60	325.08	7.08	26.05	30.72
India	177.08	313.73	461.91	1,367.22	72.13	71.89	102.68
Ireland	21.23	47.77	96.87	216.11	32.52	97.82	29.31
Israel	22.64	55.09	124.75	199.46	45.02	75.12	33.18
Italy	460.63	1,135.54	1,100.56	2,121.12	26.77	17.04	2.27
South Korea	64.39	270.41	533.39	991.15	152.90	88.25	47.51
Mexico	205.66	262.71	628.85	995.92	20.27	40.70	17.77
Netherlands	178.38	295.46	386.20	797.45	24.78	35.18	13.48
Norway	63.71	117.62	168.29	433.30	28.21	43.88	18.83
Poland	56.62	62.08	171.26	479.03	-1.38	44.65	44.88
Portugal	31.18	75.97	112.98	225.97	44.73	34.28	5.33
Spain	224.50	520.71	582.38	1,424.69	33.93	32.96	22.44
Taiwan	42.23	164.97	326.16	418.21	108.51	83.04	40.37
Turkey	**94.26**	**202.38**	**266.44**	**710.74**	**65.75**	**43.35**	**41.00**
UK	542.45	1,017.79	1,480.53	2,222.63	30.75	28.45	15.61
USA	2,788.15	5,800.53	9,951.48	14,799.56	37.59	39.73	19.28

Data: IMF World Economic Outlook Database, April 2010
**GDP constant prices in national currency are used to calculate the growth rates in order to take into account the country inflation.
*IMF Estimates

Even if Turkish economic growth since 1980 has not matched highly successful east- Asian or select Latin American countries, the nation did attain the status of an upper level middle income county. Its post WW-II economic development history is one of turbulence but relative success in terms of economic growth and industrialization. However in the 1990s, with strenuous efforts to push forward European integration it became clear that a more aggressive transformation oriented to higher value added production, higher technical standards and a more meaningful role for endogenous innovation was needed. Most recently the Turkish economy recovered rapidly after the

2001 recession and registered significant growth of 40.5 percent between the years 2002 and 2008 (IMF World Economic Outlook, 2010). Meanwhile, national exports increased more than 4 times from $36,059 million in 2002 to $ 132,003 million in the same period (Taymaz 2009).

Table 4.2: GDP per capita, current prices, (US Dollars)**

Countries	1980	1990	2000	2010*	Growth 80-90	Growth 90-00	Growth 00-10
Argentina	7,478	4,345	7,730	8,493	-23.69	33.73	31.57
Brazil	1,372	3,464	3,762	9,886	-5.68	9.96	24.15
China	313	341	946	3,999	109.66	143.23	146.85
Denmark	13,610	26,454	30,034	56,790	22.49	24.49	2.80
France	12,865	22,017	22,576	42,414	20.40	16.80	6.14
Germany	10,750	19,593	23,168	40,679	22.18	17.81	6.37
Greece	5,563	9,073	11,662	29,060	1.62	17.05	27.86
India	256	364	443	1,124	38.28	42.14	73.78
Ireland	6,243	13,626	25,562	48,578	28.56	83.01	10.15
Israel	6,014	12,204	20,504	26,843	20.92	29.93	9.04
Italy	8,169	20,029	19,293	35,231	26.09	16.32	-3.11
South Korea	1,689	6,308	11,347	20,265	124.90	71.68	41.78
Mexico	3,044	3,157	6,419	9,168	-2.36	19.53	6.21
Netherlands	12,606	19,761	24,250	48,224	18.08	26.92	9.29
Norway	15,569	27,677	37,391	88,590	23.46	35.85	9.35
Poland	1,591	1,625	4,454	12,575	-8.14	43.70	46.25
Portugal	3,192	7,600	11,082	21,185	41.46	31.66	0.67
Spain	6,005	13,408	14,464	30,960	28.93	28.25	7.13
Taiwan	2,363	8,086	14,641	17,927	82.60	67.63	34.05
Turkey	**2,235**	**3,860**	**4,245**	**9,950**	**33.31**	**19.76**	**23.89**
UK	9,630	17,782	25,142	35,721	28.67	24.85	9.41
USA	12,249	23,198	35,252	47,702	25.25	23.77	8.53

Data: IMF World Economic Outlook Database, April 2010
*** GDP per capita constant prices in national currency are used to calculate growth rates in order to take into account inflation in countries.
*IMF Estimates

The high growth rates in the 2000s were mainly driven by the medium-tech automobiles (motor vehicles) and consumer electronic sectors (TV/radio receivers) which increased their exports significantly between 2002 and 2008 (510.5 % and 192 % respectively). However, given the recent crises in the world economy, export of motor vehicles has slowed down and export of TV/radio receivers has significantly diminished after 2005 (88.7 % and -31.25 % respectively) due to lack of interest in international markets, mostly in EU countries. The most recent crises once again highlighted the limits of purchasing or imitating foreign technologies (with a lag) and the inadequacy of enhancing competitiveness of domestic firms by reducing costs, cutting real wages, lowering taxes and subsidizing inputs (Taymaz 2009). For sustained competitiveness of the country[35], it again appeared that domestic firms have to be encouraged and supported to make moves towards higher value added products and services.

As Turkey attempts to move toward European integration and advance into the club of high income countries, the nation's history of industrialization presents both barriers and opportunities. The long term history is clearly dominated by a state-led development pattern with major shifts in the fundamental policy framework between inward-looking infant industry building and import substitution policies and more open export oriented policies. This history has generally placed private sector firms in a dependent and reactive mode vis-a-vis state policy and may have stifled, to some extent, efforts to improve inter-firm organization and collaboration. In addition, the strong role of the central state in the design and implementation of macroeconomic, trade and industrial policies did not incorporate any clear ideas about the role of regional specialization or agglomeration. These patterns of top down economic management present formidable challenges for more effectively designed, industry specific science and technology policies. On the other hand, over the course of Turkish modernization, especially in the post WW-II period, the central government has made significant

[35] According to the World Economic Forum's Global Competitiveness Reports, Turkey's historical Global/Growth Competitiveness Rankings among other countries are as follows: 2001(54); 2002 (65); 2003 (65); 2004 (66); 2005 (66); 2006-2007 (58); 2007-2008 (53);2008-2009 (63).

investments in higher education, workforce training, and in the establishment of national institutions associated with science and technology. These investments provided an important initial foundation to support more systematic efforts to accelerate technical change and innovation in the current period. The following sections will review the historic evolution of the institutional and policy framework supporting the development of science, technology and innovation. A special emphasis will be placed on how the historic evolution of these institutions and policies has both helped and hindered contemporary efforts to build up the elements of a national innovation system.

4.2 Developmental History of Turkish Science, Technology and Innovation Policies

4.2.1 Recognition of Science and Technology as a Separate Realm: The Planned Period of 1960-1977

The identification of science and technology as a distinct realm of national policy did not really come to the foreground until the late 1940s. In particular, the idea that public sector investments and polices related to higher education and publically financed research and development was central to national security and economic growth performance was novel. The notion of a discrete realm of science and technology policy first emerged with the work of Vannevar Bush and other scientists and engineers in the U.S. and Europe who had been engaged in the war effort. Bush and others argued that government had an important steering role in supporting technological innovation and entrepreneurship to ensure both economic and geopolitical security (Zachary 1997). It is noteworthy that the early proponents of a government leadership role in technology and innovation were some distance ahead of neoclassical economists in fully recognizing the substantial public goods nature of research and development and the prominent role of science and innovation in national growth performance. In the late 1940s and early

1950s in the U.S. and elsewhere, national scientific bodies linked to central governments promoted and invested in higher education, research and development based on national security and national competitiveness rationales. The discrete field of science and technology policy was hence born in this period.

In Turkey both the discourse and the public sector actors that began to discuss a national science and technology policy emerged as byproducts of the planned era and the Republican modernization project. As touched upon in the previous sections, the objective of the new Republic was to create an industrialized modern state, in an environment of limited capital and government revenue. The founders of the Republic drew upon the ideals of science to guide their modernization objective and focused on the establishment of universal education as an essential step in transforming a peasant society with low levels of literacy and education. Outstanding high-school graduates were given scholarships to be educated in basic and applied sciences in Europe and USA, and some of these graduates returned to start their own factories and build up of new industrial sectors, as in the case of sugar production. (Tekeli 2006). Moreover, a number of universities with medicine and engineering departments were established and developed with a large infusion of foreign faculty. Targeted recruitment policies were directed especially towards Jewish professors fleeing from the Nazi Germany. Many of these refugees later became very influential in developing the modern university system in the country. In addition to enhancing the scientific level of the higher education system, technological transformation also took place through extensive public expenditures and infrastructure investments including desiccation of swamps, war on epidemics, the establishment of power plants and more advanced communication and railroad networks. Consequently, the scientific visions of the ruling elite and their strong commitment to progress transformed the society's perceptions on science and technology in a way that had never occurred in the policy making arena in Turkey.

But it was only at the beginning of the 1960s that science and technology was highlighted as a separate realm which would itself contribute to the development objectives of the First Five Year Development Plan (1963-1967). In this respect, the Plan recommended establishment of TUBITAK (Scientific and Technical Research Council of Turkey) for the purposes of organizing, coordinating, and promoting basic and applied research. TUBITAK also had responsibility to set research priorities according to the targets of the Plan (DPT 1962). This new lead institution was unfortunately given responsibilities without corresponding resources and could not meet goals such as improving the research base in higher education institutes and promoting private sector R&D. The objective of doubling government expenditure on R&D (GERD) to 0.6 % of GDP could not be achieved and remained as an unrealistic target.

The third five year plan (1973-77) shifted the focus of attention from the development of basic science capacities to applied science and technology projects targeted to selected sectors. It suggested greater integration of technology policy with industry, investment and employment policies to enhance the technological capabilities of select industrial sectors that were opened to international competition. In this respect, the Plan encouraged increases in the number and quality of technical personnel; the buildup of technology transfer mechanisms; establishment of new graduate programs in sciences and engineering departments in universities, and the development of high technology in internationally competitive export sectors (DPT 1972). The principles of technology transfer and property rights received much more emphasis in this plan than in previous plans. The third plan criticized previous technology policies for their inability to establish institutional mechanisms to accelerate technology transfer and commercialization or build a system supporting generation of novel technologies (DPT 1972). The following governments, on the other hand, condemned this third plan and located the problems in the limited incentives for protected industries to invest and develop new technologies in the era of protectionist import substitution policies.

4.2.2 The Puzzle: Compelling Science and Technology Plans and Poor Implementation the 1979-1996 period

The fourth plan, prepared for the years between 1979 –1983 coming out of the military takeover years, mainly criticized the existing technological level of the country by condemning the negative impact of import substitution policies of the previous decades. Inefficient resource allocation for R&D activities, lack of sustained relationships between R&D institutions and industry, high cost of technology transfer and the low technology absorption and assimilation capability of industry were stated as the main problem areas in the Plan. All of these shortfalls were seen as endemic to a situation where national industries were shielded from international standards and competition. For the first time in the history of the country, a separate science and technology plan, Turkish Science Policy: 1983-2000, was prepared and published. The Plan suggested establishment of the Supreme Council for Science and Technology (BTYK) as the main national decision making body. The BTYK was organized to design of science and technology policies with broader participation of politicians, bureaucrats and non-governmental organization representatives from the relevant socio-economic fields of activity (TUBITAK, 1999). The Plan specifically emphasized the necessity for the design of technology policies based on the specific needs of different sectors regarding technology development and transfer. The Plan also explicitly addressed the need for better legal arrangements on industrial/intellectual property ownership rights, national quality control techniques and specialized employment programs. Unfortunately, the Plan could not be implemented due to political instabilities and lack of a strong government will and vision on technology development.

The fifth plan (1985-89) set out the need to prepare a science and technology master plan based upon the Turkish Science Policy 1983-2000 document. This policy document focused on establishing centers of excellence in some areas of basic and applied science, encouraging better university-industry relations, and establishing a national quality control system. The university-industry partnership idea emerged for the first time in Turkey with this plan. The Plan also highlighted the dependence of the country on imported technologies as domestic industry was more inclined to purchase technology from abroad than investing in endogenous research and development activities. In an attempt to stimulate domestic R&D two tax incentive schemes were adopted to encourage private investment in R&D: Decree on Tax Postponement to Support R&D (1986) and Support for R&D Investment (1986). Although inefficient and limited in scope and funding, direct tax incentives were at least an informed response to the acknowledged dependency problem in the Plan. The most important practical achievement during the course of the fifth Plan was the first meeting of the Supreme Council for Science and Technology (BTYK) in 1989 as the lead institution in charge of national science and technology policies. BTYK, established as part of the Master Plan linked to "Turkish Science Policy: 1983-2003" in 1983, was supposed to meet twice a year. The BTYK did not in fact meet until 1989 and its recommendations did not get implemented. The first meeting of BTYK simply underscored the importance of science and technology policies and lack of action by the Turkish government and private sector partners. This poor performance with respect to technology development was contrasted with rapid advances in both the industrialized and newly industrializing Asian countries.

Yet, the Supreme Council did not meet second time till 1993 as little momentum toward major reforms or new investment was generated.

The sixth plan (1990-1994), similar to previous plans, proposed new science and technology development paths for the country and called for the adoption of advanced technology transfer and technology building mechanisms and knowledge collaboration and diffusion instruments such as technology incubators and technoparks. To better nurture university-industry collaborations, the Plan prescribed the foundation of five technoparks and two advanced technology institutes. The plan gave precedence to specific advanced technology areas like ICT, bio-technology, microelectronics, nuclear technology, and advanced materials. Also, in order to meet emerging demands in intellectual property right and quality control developments, the Plan suggested the creation of the Turkish Patent Institute and National Metrology Institute (DPT, 1989).

During the period of the sixth plan, one initiative, the World Bank's Technology Development Project (1991), significantly influenced the evolution of the science and technology institutional infrastructure of the country. The Technology Development Project (TDP) aimed at:

> "(i) bringing the MSTQ [(Metrology, Standardization, Testing, Quality)] system in Turkey to OECD standards, ii) supporting private sector investment in industrial technology development by providing seed capital and subsidized grants/loans, and iii) developing a venture capital industry by establishing a legal and regulatory framework, rationalizing the tax treatment of venture capital funds (VCFs), and financing through the IFC [(International Finance Corporation)] a role model VCF and management company." (Taymaz, 2006:1)

In accordance with its objectives, TDP established several new institutions. These included the Technology Development Foundation of Turkey (TTGV), National Accreditation Council and the Venture Capital Fund/Venture Capital Management

Company. The TDP also influenced the legal and regulatory framework that was fundamental for proper functioning of these institutions in Turkey.

The implementation failures of science and technology plans until the mid-1990s were related to macroeconomic instability including high inflation rates and boom-bust cycles, and a fragile banking system not positioned to expand private sector lending. In these conditions the institutional restructuring and institution building needed to significantly advance performance could not get off the ground In the early 1990s, the Turkish government had to again reiterate the importance of science and technology policies in its economic growth goals as the rules of the games in international markets were changing with the revolutionary developments in information and communication technologies. In this context the Supreme Council for Science and Technology (BTYK) became active again; meeting for a second time in 1993. They approved a new framework, the Turkish Science and Technology Policy: 1993-2003, which formed an integral part of the 7th Five Year Development Plan (1996-2000) in Turkey. This plan also failed to take hold but finally the BTYK met a third time in 1997. After this third meeting, pressured by the rapid technological change in global information and communication technologies, the government finally realized the crucial need to prioritize technological development to sustain national competitiveness. With the need to reform science and technology policies in a rapidly changing global economy the finally recognized BTYK became more effective in designing and actually implementing new policies. Most noteworthy, the BTYK explicitly called for the establishment of a national innovation system (NIS), indicating a paradigm shift in the conception of science and technology policies in Turkey. Starting from 1997, the Supreme Council has held its meetings regularly and set and monitored policy targets in accordance with the national development plan.

After generally being put to the side in prior five year development plans the "Science and Technology Policy: 1993-2003", became the most comprehensive strategic document delineating industry, innovation and technology strategies and specific goals for the country. The strategy document contained somewhat familiar calls to enhance the intellectual capacities; upgrading the R&D ability of the country in the new pervasive generic technologies (information technology, advanced materials, biotechnology, nuclear technology and space technology); using these new abilities in economic priority areas. However, the strategy focused much more directly on accelerating diffusion of technologies in target areas and transferring basic and applied research results to meet economic and social priorities.

Most significant, the new policy document set four specific outcome targets for the years 1993-2003: 1) to increase the number of researchers per 10,000 people from 7 to 15; 2) to raise the GERD[36] (Gross Domestic Expenditure on R&D) to GDP ratio from 0.3 percent to 1.0 percent; 3) to move up in the rank of scientific publications from 40th to 30th position; and 4) increase the share of business in total GERD from 18 percent to 30 percent. (Taymaz 2006:4). Further, to achieve the stated targets, the "Science and Technology Policy: 1993-2003" was converted into a specific action plan, "The Project of Impetus for Science and Technology" (TÜBİTAK, 1996), within the scope of Structural Transformation Projects in the 7th Five Year Development Plan. The 7th development plan emphasized greater involvement of private sector in R&D investments, establishment of national R&D networks and technology development zones, greater involvement of academicians in R&D activities, generation and support of venture capital structures and government procurement of technological products.

[36] Gross domestic expenditure on R&D (GERD) includes expenditure on research and development by business enterprises, higher education institutions, and government and private non-profit organizations.

The review of the plans and projects undertaken within the scope of science and technology development in Turkey especially during the 1980s and early 1990s show that scientific and technological development had always been prominent in the planning discourse. However, science and technology policy was never prioritized in national economic policy and never received the attention or investment commitments to push change. This is especially clear when efforts in Turkey are contrasted with the much more massive and systematic efforts in East Asian industrializing countries. The policies and actions that did influence technological change and innovation were mostly reactive. After the liberalization of foreign trade policies in 1980s and subsequent international agreements with GATT/WTO (1989) and European Customs Union (ECU -1996), Turkey adopted a number of policies to promote competition including export subsidies. In order to replace direct export subsidies with subsidies for R&D that were legal under GATT TUBITAK initiated an industrial R&D support program in 1995. These R&D subsidies were also a response to more open trade competition.

When Turkey and the EU signed the customs union agreement in 1996 this allowed most industrial goods to trade freely between Turkey and EU countries. While access to broader markets provided a great opportunity for Turkish firms, it also made them vulnerable to technologically advanced products competing in domestic and international markets. The effects of the Customs Union agreement made both public and private sector leaders realize that Turkish industry needed to upgrade its low-tech, labor intensive products to higher value added and high quality products. The final major event that happened at the end of the 1990s and influenced many major developments in 2000s was Turkey's recognition as a candidate for full membership to European Union at the end of the 1999. To accede to the EU, Turkey was first expected to successfully complete negotiations with the European Commission on each of the chapters of the acquis - the total body of EU law. In this process, negotiations started with the science and research chapter in 2005.The chapter is closed with the assessment that Turkey has the legal and institutional grounds and conformity to implement the science and research objectives of the EU acquis in 2006.

The more serious efforts to prioritize science and technology policy which began in the early 1990s culminated in the 8th national development plan, Mid-term Program (2006-2008) and National Science and Research Strategy: 2005-2010. This plan committed to a 113 percent increase in the state budget in 2005 to fund research initiatives. These documents also evaluated existing strategic plans and administrative success at implementing the innovation oriented science and research objectives in Turkey.

4.2.3 The Systems Perspective: Late 1990s - Present

So far we have reviewed the evolution of five-year development plans and associated science, technology and innovation policy documents. This planning framework is itself an artifact of the state led planning era, but has provided some positive and consistent impetus to consider the status of science and technology policies in light of economic and development challenges facing the country[37]. The plans set the basic framework and indentify the main objectives and targets for the planning period. The State Planning Organization (DPT) is responsible for the organization of specialized committees in each area, including science and technology, and their participatory configuration at the highest level. Since 1997 the science and technology planning process has become more systematic and has become a major priority in national

[37] Only the 9th Plan, the last development plan covering the period (2007-2013), is prepared for 7 years to adjust to European Union's planning period.

economic and industrial policy. The concrete objectives and strategies of the development plans are reviewed and amended with mid-term and annual programs. And specific action and implementation plans are prepared and implemented by the individual institutions represented in the Supreme Council of Science and Technology (BTYK).

The Supreme Council of Science and Technology (BTYK) now has both an advisory and executive role in the preparation and implementation of development and mid-term plans. BTYK decisions are accepted as a Circular of Prime Ministry and they are binding over the actions of public institutions. The strategic plans prepared by these public institutions not only guide their own implementation practices but also inform BTYK and enrich its advisory position in preparation of development plans and mid-term programs.

The systems perspective in the design of science, technology and innovation policies in Turkey has continued with the 8th (2001-2005)[38] and 9th (2007-2013) national development plans. These contemporary plans elaborated and built upon the major objectives of the first major systematic plan "Turkish Science and Technology Policy: 1993-2003". These plans introduced new strategies, the implementation of which were scrutinized through implementation plans and other strategic documents such as "Vision 2023: Science and Technology Strategies", "National Science and Research Strategy:

[38] The 8th five-year development (2001-2005) set the main targets for the first half of the 2000s as becoming an information society and achieving competitiveness in international markets with the driving force of science and technological development. In this respect, the main policy priorities were determined as increasing university and public-private sector cooperation; increasing public support to research; and supporting research projects mainly on priority areas of advanced new materials, bio, nano, information, clean energy, nuclear, and aerospace technologies. The measures taken in the noted areas are expected to increase GERD to GDP ratio to 1.5 percent (0.79 %) and number of full-time R&D personnel per 10,000 to 20 (24.5) in 2005 (The numbers in parentheses show the real values in 2005. In 2008, Turkish Statistical Institute recalculated the GDP series and according to new figures GERD to GDP ratio decreased to 0.59 % in 2005).

2005-2010", "National Innovation Strategy: 2008-1010" and "International Science, Technology and Innovation Strategy: 2007-2010".

Despite considerable developments since late 1990s, the country's ability to generate knowledge and utilize it for socio-economic development remained low in comparison to most advanced countries. A sober assessment of science and technology measures and their impact on industrial competitiveness motivated policy makers to approach the problem holistically and to create a shared science and technology vision among private and public science and research actors. On December 2001, the Supreme Council for Science and Technology (BTYK), approved the first foresight project entitled "Vision 2023: Science and Technology Strategies" to create an innovative economy by the 100th anniversary of the foundation of the Turkish Republic. This Vision process adopted a bottom up approach that was novel to Turkish planning and governance traditions. The goal was to determine priority areas to enhance national competitiveness and to introduce system actors to each other and increase actors' motivation and willingness to implement the adopted policies. The new project became an important driver of the developing national innovation system as it promoted the value of horizontal interactions among actors with respect to formulation and implementation of innovation-oriented policies.

Vision 2023 was mainly a technology foresight initiative together with 3 other sub-projects aimed at collecting and evaluating data on the technological capacity, R&D manpower and R&D infrastructure of the country. TUBITAK, as the responsible institution for the organization and implementation of the project, organized a steering committee which consisted of 65 representatives from 27 governmental organizations, 9 universities and 29 industrial organizations and NGOs. Regarding the execution of the project, 12 technology foresight panels in education and human resources; environment and sustainable development; information and communication; energy and natural resources; health and pharmaceuticals; defense, aeronautics and space industries; agriculture and food; machinery and materials; transportation and tourism; textiles; chemicals and construction and infrastructure were formed which conducted more than 200 meetings. A two-stage Delphi survey was carried out to support panel deliberations that evaluated the opinions of thousands of professionals and experts to assess the likelihood of achieving envisioned technology developments in different technology/industrial areas. The prepared synthesis and evaluation reports documented 94 technology roadmaps in priority fields. The final strategy document, adopted on March 2005, identified eight strategic technology areas: ICT; bio and genetic research; energy and environment; materials; nanoscience; design; production and machinery technologies and mechatronics.

The Vision 2023 Project was a major development in that it expanded participation outside the state bureaucracy to multiple voluntary stakeholders. These stakeholders were motivated and encouraged by the possibility of generating a sophisticated technology foresight document that incorporated knowledge and expertise from a large number of actors in science and technology and that would be implemented and supported through a strong government commitment and coordination. The project did have its critics who argued that wide participation led to identification of too many priority fields given the limited financial and technological capacities of the country, its neglect of necessary feedback mechanisms with respect to the development of fast paced technologies and its lack of emphasis on public R&D support programs. Despite these criticisms, the Vision 2023 strategic document was translated into concrete actions with the National Science and Research Strategy: 2005-2010.

The National Science and Research Strategy: 2005-2010 defined a set of seven actions to meet national objectives and new targets for the year 2010 which included increasing Gross Expenditures on Research and Development (GERD) as a percentage of GDP to 2% (from 0.73 in 2008), with half of GERD coming from the private sector and raising the number of full-time equivalent researchers by 40,000 (from 53,000 in 2008). The adopted set of actions were to enhance awareness of science and technology in the society, to educate more researchers and enhance their capabilities; to support outcome oriented and qualified research which can be translated into innovation and productivity gains; to coordinate and manage national science, technology and innovation system more efficiently and effectively; to strengthen research and technology development performance of private sector; to improve research environment and infrastructure; and to enhance national and international linkages.

The identified action areas mainly reflected weaknesses of the developing national innovation system. The government backed the strategy and allocated additional funding of approximately $650 million for the years 2005 and 2006 from the national budget. This represented a major breakthrough. For the first time there was a substantial national commitment to build up the national science and technology base with $1.5 billion budgeted for the initiatives in the strategy in 2008 The increased R&D funding resources supported a number of policy instruments and programs, which will be discussed in detail Chapter 5 in regards to the characteristics and performance of the NIS. But the 9th and last development plan (2007-2013) adopted some bold general objectives in science and technology development including: an increase in overall R&D expenditures to 2 % of GDP by 2013 (from 0.73 in 2008); commitment to raise the share of private sector spending in R&D to 60 % (from 44.2 % in 2008); expand the full time equivalent number of researchers to 80,000 (from 53,000 in 2008); and augment the internet penetration rate to 60 % of households by 2013 (from 20 % in 2008).

To date, planning and investment in the Turkish science, technology and innovation framework emphasized progress toward basic outcome measures of science and technology performance (such as R&D/GDP ratios and others noted above). This view of science and technology policy success is valid because basic capacities have to be built up in the public and private sector institutions and basic experience in integrating ongoing research and development into actual technology upgrading and innovation activities is a necessary foundation for the further evolution of the NIS. Building more efficient and effective interactions through better orchestration of NIS actors could not be achieved without meaningful resources, capacity and initial experience. It was also critical to show that support systems were durable, and most importantly build up an awareness of the value of research and development commitments for firm growth and profitability. The basic metrics in the last three plans emphasized improvement in private sector's R&D capacity and demand together with private and public sector cooperation, including universities. Such cooperation was not present in previous periods.

In the current period the NIS construction process has begun to address more direct economic versus science and technology performance outcome measures for national policies such as patent activity, international competitiveness indexes, percentage of high-technology products in total exports, etc. These economic measures have remained relatively low and have not clearly responded to improvements in the key science and technology indicators over the past 10 years. Moving on to focus on these measures has forced policy makers to focus national strategy documents on the character of public private relationships and organizational barriers to technology commercialization. The National Innovation Strategy: 2008-2010, for instance identified the six major objectives as entrepreneurship, efficiency and innovation; science and technology transfer to private firms; competitiveness; research infrastructure and environment; governance and international cooperation, the last of which was further elaborated in the International Science, Technology and Innovation Strategy: 2007-2010 document.

Each objective is analyzed and a number of action areas are identified in the document. These action items are directed toward building knowledge, know-how and relationships among the actors in the system, including creating an awareness that R&D and research commercialization was essential for the long term competitiveness of private firms; improving the human resources within the firms and developing policy designs to accelerate technology and knowledge transfer; developing world class ICT, especially e-commerce; improving the active seeding and management of innovation activities in technoparks; and business incubators; improving coordination among organizations that fund R&D activities. Each of the fields requires a level of detailed policy development and management of human resources and funding that suggests a further evolution of the NIS.

In sum the articulation and serious government commitment to a national science and technology policy did not really occur until the mid-1990s. After several stops and starts, Turkey's mediocre industrial and growth performance combined with external pressures stemming from the EU integration project pushed the central government to prioritize science and technology policy. This led to a more serious and coherent series of plans and initiatives to improve the nations technological and innovative capacities. However, given the long history of central state dominance over industrial and technology policies and the somewhat dependent and reactive status of private firms in advanced industrial areas, building capacities for technology upgrading and innovation necessitated transcending an entrenched bureaucratic structure and expanding participation in policy making and implementation. Another interesting byproduct the history of centralized Turkish industrial and technology planning is the absence of any focus on regional industrial specialization, agglomeration or innovative capacity. The following chapter will examine the contours of the recent technology and innovation policy making from the perspective of those actively involved in the process. The more specific barriers and possibilities for further development and articulation of the NIS in Turkey from the perspective of policy makers and those actually implementing programs will be carefully analyzed. This assessment will then be compared and contrasted with the actual activates and experiences of firms that have begin to participate in the new technology and innovation programs fostered by the plans.

Chapter 5: Evaluating the NIS Construction Process in Turkey

As emphasized in the prior chapter, the evolution of industrial and science and technology policies in Turkey can be characterized by three major transitions. The first was the change in national macro and trade policy from the strong protection of domestic markets with import substitution policies of 1960s and 1970s, to the reduction in protections and export-led growth strategies of the 1980s and to the present period. The second transition, that further exposed Turkish industry to international competition, was centered on the acceleration of the EU integration project in the mid-1990s with planned entry into the Customs Union and subsequent initiatives. This process put into sharp relief the need for a serious focus on science and technology policy backed with real public sector investment to compete against European firms in higher value added and more technologically advanced product and service markets. The third transition, the development of a systematic science and technology strategy at the dawn of the 21st century, was associated with more liberal trade policies and EU integration, but involved for the first time a focus, and real resource commitments, to a coherent NIS construction process. This chapter will concentrate on the 1997-2007 period of policy making, institution building and efforts to generate complementarities and associations between the individual elements of the emerging NIS.

In a developing country context, adoption of NIS framework to shape science, technology, and innovation policies is premised on the prevalence of market failures in the domains of technology development and innovation. As noted in the literature review, positive externalities and information failures are prevalent in R&D and technology adoption processes. Addressing these market failures through strategic interventions that valorize the social benefits of R&D and improve the quality and efficiency of information flows is fully consistent with the allocative efficiency advantages of markets. The NIS framework is actually a mid-way between the "pure market view" that is deeply skeptical of the efficacy of state involvement in addressing R&D market failures and more traditional "state-led development" models where government planning organizations strongly direct industrial investment and the technology development of domestic firms (Teubal 2002). The roles attached to actors in public and private sector institutions in the NIS framework are contingent on context. To understand more deeply the NIS construction process in Turkey the prior experiences of the public and private sectors must be considered as well as the initial levels of institutional capacity.

As articulated in the theory and literature review chapter, new developmental state theories emphasize that nation states have diverse choices in their efforts to stimulate innovation-based industrial growth. Some cases, such as Israel and Taiwan have linked science and technology policies more tightly to targeted industrial development policies. A distinctly different example is Ireland which focused much more on attracting foreign technology and high-tech firms and linking domestic science and technology institutions to these lead firms through partnerships and joint ventures with local firms. National innovation systems share a number of common framework elements but the development, relationships and specific interactions among the elements depend on the unique structures and historic patterns shaping productive forces and capabilities in a specific nation state (Breznitz 2005, Freeman 1987, Evans 1995). However, the literature also shows that innovation based growth actually emerges at the specific "industrial sector level and at the level of particular state agencies" rather than at the national level, because they have more direct impact on firm strategies and investment decisions that demark the move toward innovation led growth (Breznitz 2005: 315).

Turkey is an unusual case of a country with a long history of central government direction of the economy, but with little history of a strong, targeted industrial policy. As a developing country without a coherent industrial policy, it is aiming to advance its economic growth and competitiveness objectives by providing technology and innovation support to firms and sectors based on perceived capacity and likelihood of success rather than industrial or product specialization. In a certain sense the developing innovation system then becomes a leading shaper of industrial growth and change as it selects the firms and institutions seen to have the greatest prospects for technology upgrading and innovation. Clearly, application of an NIS conceptual framework to influence firm and institutional behaviors is not an easy task and necessitates substantial policy making and implementation capabilities which transcend goals of simply targeting improvement in major science and technology indicators. Achieving growth and competitiveness targets requires that system elements function over time to actually increase the pace of technological change and innovation in firms delivering products and services to markets.

For every nation, there is continual experimentation with the design of the NIS and nations with clear objectives and a durable commitment handle better the evolution of these complex formations. National goals and challenges transform the priorities, policies, programs, and funding mechanisms of the countries and as experience is gathered and as policy learning is achieved, new elements are incorporated into the system and others are diminished or discarded. The first objective of this chapter is to review the basic resource base underpinning the NIS construction project in Turkey – the major science and technology indicators in Turkey and their relationship to indicators other middle and upper income countries. Given this base, the second major aim is to understand how the contemporary NIS construction process is trying to bring science and technology assets to bear to actually enhance innovation performance in firms and R&D

institutions. In this area the major discussions on the Turkish NIS construction and design processes, institutionalization, strengths and weaknesses of existing programs will be analyzed. Finally, the views of officials and leaders of programs engaged in the NIS construction process will be evaluated on issues including the applicability of the concept in Turkey; major institutional, legal and financial restructuring challenges; and the difficulties of aligning public institutions and specific support programs with the capacities and needs of private sector partners.

5.1. Major Science and Technology Indicators in Turkey

A decade after the first appearance of the NIS concept in the national policy discourse, Turkey's gross domestic expenditures on R&D (GERD) as a percentage of GDP reached to 0.76 % in 2006 in comparison to 1.88 % in EU-15 and 2.26 % in total OECD countries, reflecting major room for improvement relative to EU or OECD averages. But, this share is similar to or higher than other middle income countries such as Portugal (0.83 %), Mexico (0.50 %), Poland (0.56 %) and Greece (0.50 %) and its growth rate is considerably higher than those of all these countries. Even though GERD has increased substantially over the years, with a growth rate of 69 % from 0.45 % in 1996, it is still well short of the 2 % of GDP target for 2013[39].

The review of major science technology and innovation policy documents in Turkey shows that increasing business expenditure on R&D (BERD) has been a major policy objective especially during the NIS construction phase as businesses account for

[39] In interpreting and comparing growth rates between countries, it must be remembered that GERD to GDP ratio reflects changes in countries' nominal spending on R&D and changes in their economic growth. In other words, diminished R&D intensities could be linked to either decreasing R&D spending and/or faster growing GDPs. Therefore, nominal spending accounts must be interpreted in context as they don't reflect the efficiency and effectiveness of spending and as well the features contributing to absorption, creation, and diffusion of knowledge.

majority of the R&D performed in advanced countries. Business-performed R&D is usually associated with the creation of new products and techniques rather than the research performed in universities and public research institutions.

Figure 5.1 GERD as a % GDP, 2006

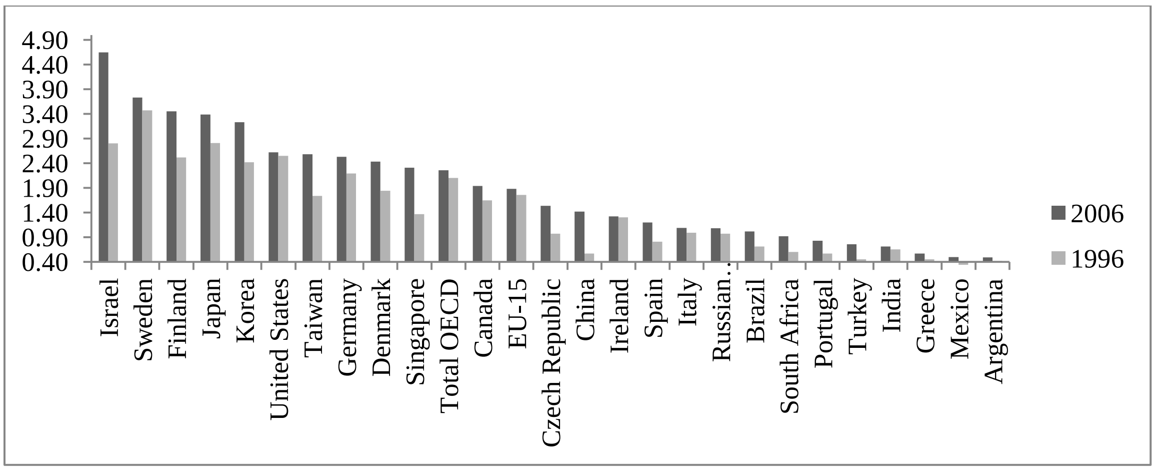
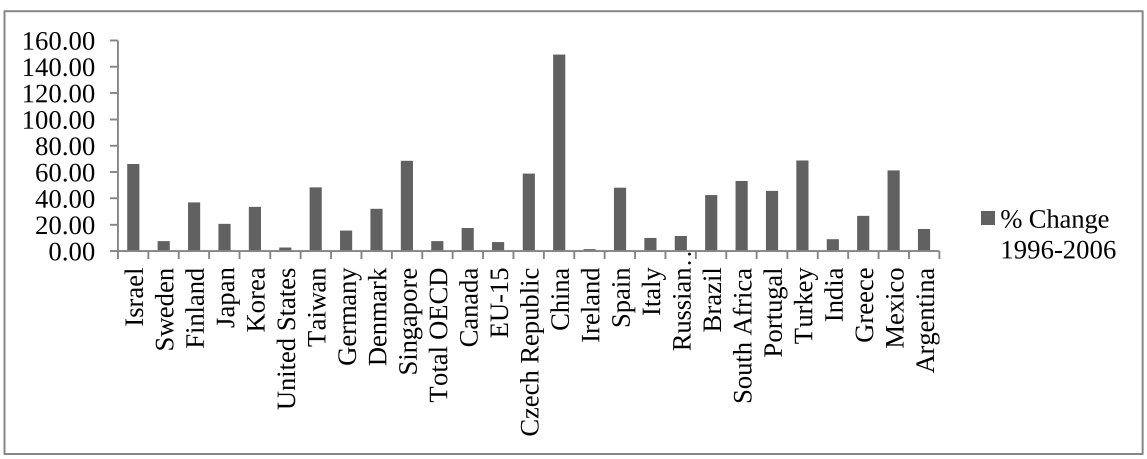


Figure 5.2 Growth of GERD as a % GDP, 1996-2006



In Turkey, BERD as a percentage of GDP increased significantly from 0.12 % in 1996 to 0.28 % in 2006, but it remains low in comparison to many other EU and OECD countries, even though the increased share is similar to what is found in many middle income developing countries such as Poland (0.17 %), Portugal (0.35 %) and Mexico (0.25 %).

Figure 5.3 BERD as a % GDP, 2006

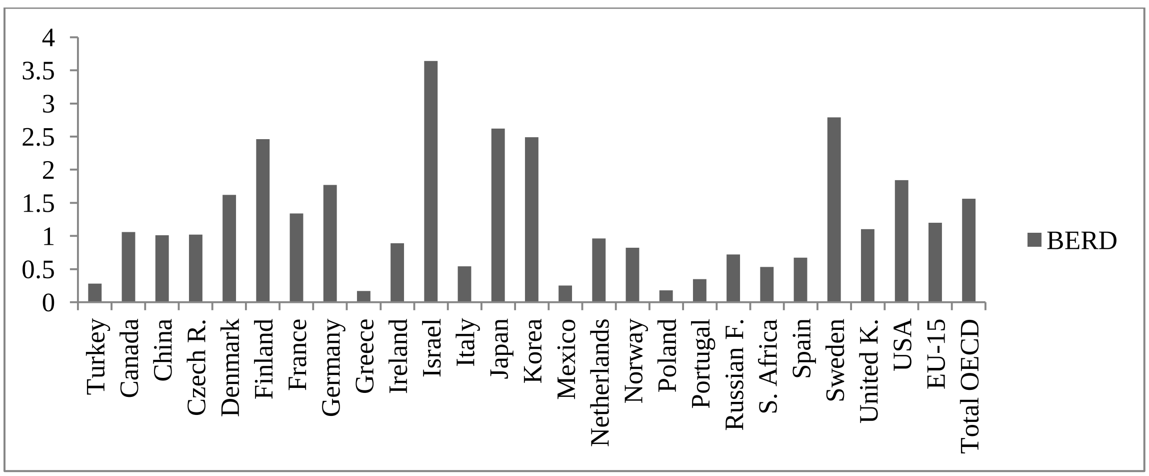
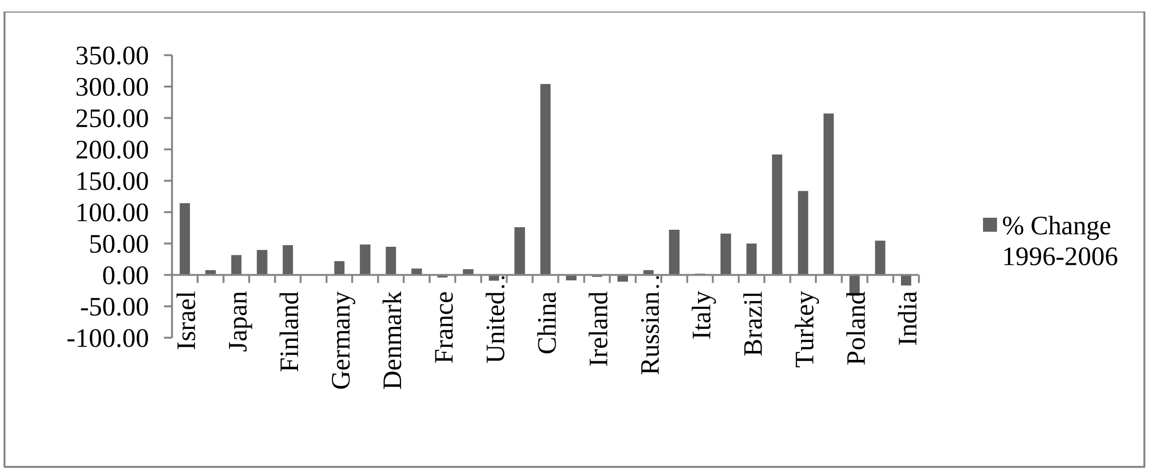


Figure 5.4 Growth of BERD as a % GDP, 1996-2006



Variations in BERD intensity among countries are primarily caused by their industrial specialization and demographics of their businesses as some industries are more R&D intensive than others, and some countries have bigger shares of large R&D performing firms in their business population. In most countries with high levels of business R&D intensity, R&D is concentrated in firms with more than 500 employees.

Table 5.1 R&D Expenditure by Type[40], 2006

Countries	GERD	BERD	GFRD	HERD	HERD-Industry
Turkey	**0.76**	**0.28**	**0.37**	**0.39**	**23.8**
Canada	1.94	1.06	0.63	0.69	8.4
China	1.42	1.01	0.35	0.13	36.6
Czech R.	1.54	1.02	0.60	0.25	0.7
Denmark	2.43	1.62	0.68	0.63	2.4
Finland	3.45	2.46	0.87	0.65	6.6
France	2.11	1.34	0.82	0.38	1.6
Germany	2.53	1.77	0.70	0.41	14.1
Greece	0.57	0.17	0.27	0.27	8.9
Ireland	1.32	0.89	0.40	0.34	1.8
Israel	4.65	3.64	1.03	0.62	7.6
Italy	1.09	0.54	0.55	0.33	1.4
Japan	3.39	2.62	0.55	0.43	2.9
Korea	3.23	2.49	0.74	0.32	13.7
Mexico	0.50	0.25	0.23	0.14	1.1
Netherlands	1.67	0.96	0.64	0.49	6.8
Norway	1.52	0.82	0.67	0.46	4.7
Poland	0.56	0.18	0.32	0.17	5.4
Portugal	0.83	0.35	0.44	0.29	1.2
Russian F.	1.08	0.72	0.66	0.07	29.31
S. Africa	0.92	0.53	0.35	0.18	11.59
Spain	1.20	0.67	0.51	0.33	7.9
Sweden	3.73	2.79	0.89	0.76	5.2
United K.	1.78	1.10	0.57	0.47	4.8
USA	2.62	1.84	0.77	0.37	4.9
EU-15	1.88	1.20	0.63	0.42	6.6

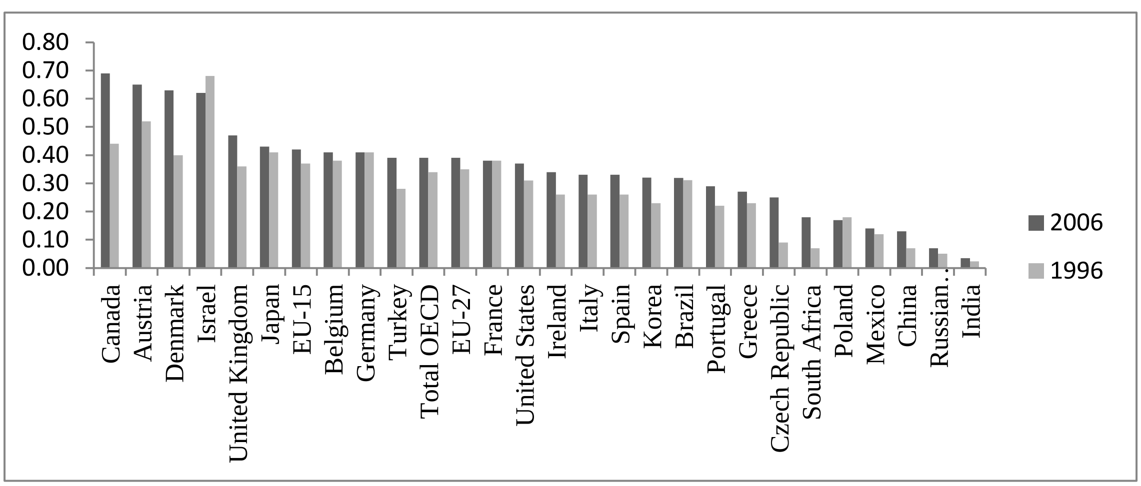
Source: OECD Science, Technology and Industry Outlook 2008.

[40] GERD: Gross Domestic Expenditure on R&D; BERD: Business Expenditure on R&D; GFRD: Government-financed R&D; HERD: Higher Education Expenditure on R&D

More than 80 % of business R&D in Germany, Japan, Korea and USA is undertaken in large businesses (OECD, 2008). The ratio is 67 % in Turkey which is considerably high in comparison to Greece (34.4 %), Portugal (50 %) and Poland (49 %) (OECD, 2008). Even though R&D is concentrated in large firms in advanced countries, SMEs are still important players, especially with the increasing R&D investment in the services sector. Low R&D intensity among SMEs in Turkey which constitute the majority of the business population is recognized and addressed in policies such as SME Strategy and Action Plan (2007-2009) to increase SMEs interest in product development and boost their capacities through training programs and incubators to ease their access to global suppliers and national universities.

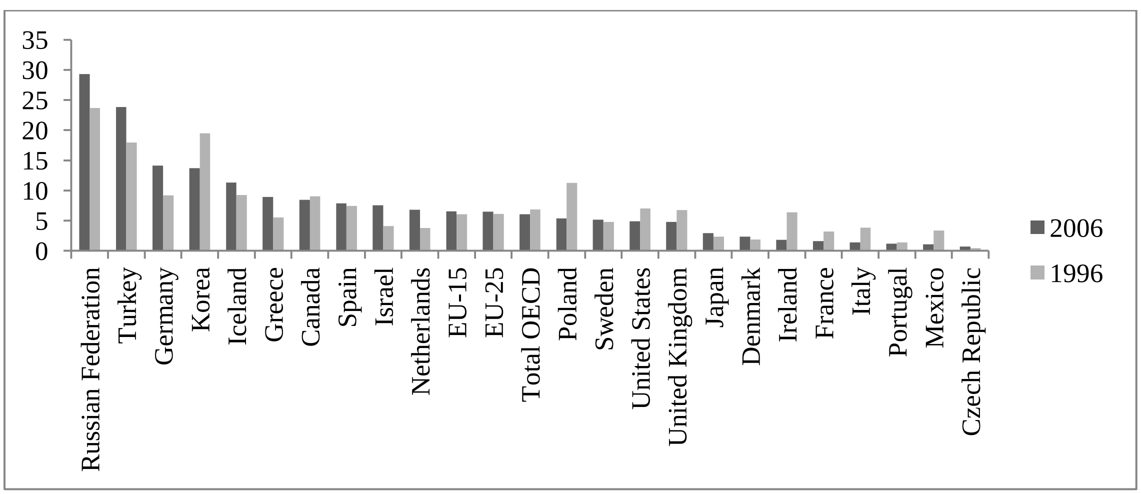
Government-financed R&D (GFRD) in Turkey also remains low compared to EU or OECD norms and is far below rapidly growing countries such as Israel and South Korea. GERD increased from 0.26 % in 1996 to 0.37 % in 2006. Especially after 2004 when the central government pushed a large increase in public R&D budget, increased government expenditure has been criticized for causing an artificial increase at BERD.

Figure 5.5 HERD as a % of GDP, 2006



Perhaps the most interesting element of these indicators is the relatively large share of higher education R&D expenditures (HERD) in Turkey (0.39 %). As the most prominent sector of R&D, higher education is a central element in the newly forming Turkish NIS. Government is the biggest funder of R&D in the Turkish university system but private sector support for university R&D is strong as well. The share of HERD financed by industry appears as an indicator of important linkages business and higher education sectors, and these interactions are noteworthy for the construction of a dynamic NIS in Turkey. The relatively high share of HERD financed by industry for Turkey, 28.3 % of total HERD in 2006, show that at minimum there is a pattern and history of partnerships and knowledge transfer between those two sectors.

Figure 5.6 HERD financed by industry, 2006



Another policy priority in science, technology and innovation has been the development of an educated workforce and a science and engineering researcher base since mid-1990s. While R&D personnel per thousand employees was very low in Turkey in 1996 in comparison with EU or OECD countries, growth over the 1996-2006 period has been has been robust (see Table 5.2). Total R&D personnel per thousand total employment went up to 2.4 percent in comparison to 10.2 in EU-27 countries and 10.3 in South Korea. Likewise, there was healthy growth in engineering degrees as a percentage of total new degrees and engineering PhDs per million population, which were 11.9 % and 6.0% in 2005 in Turkey. This was higher than many middle income countries, but lower than rapidly developing countries such as Israel with 11.81 % and 12.9% respectively and 27.07 % and 47.1% in South Korea.

Table 5.2 R&D Personnel per Thousand Total Employment, 2006 Average Annual Growth Rate of R&D Personnel between 1996 and 2006

Countries	R&D Personnel 2006		Growth of R&D Personnel (1996-2006)	
	Researchers	Other S&T	Researchers	Total
Turkey	**1.9**	**0.5**	**9.0**	**9.5**
Canada	7.7	4.6	4.2	4.2
China	1.6	0.4	8.4	6.5
Czech R.	5.2	4.2	7.3	7.3
Denmark	10.2	5.9	5.5	3.5
France	8.2	5.9	3.1	1.1
Germany	7.2	5.3	2.1	0.8
Greece	4.3	3.3	6.9	6.4
Ireland	6.0	2.7	6.6	5.8
Italy	3.4	3.8	0.8	2.3
Japan	11.1	3.5	1.4	0.5
Korea	8.7	1.6	7.2	5.8
Mexico	1.2	1.0	10.4	11.4
Netherlands	5.5	5.8	2.6	1.6
Poland	4.4	1.0	1.3	- 1.2
Portugal	4.1	0.9	5.9	4.9
Russian F.	6.8	6.6	- 1.9	- 1.9
Spain	5.8	3.7	8.4	8.0
United K.	5.8	4.8	2.4	2.1
EU-27	**6.0**	**4.2**	**3.1**	**1.9**

Source: OECD Science, Technology and Industry Outlook 2008.

Table 5.3 Triadic Patents per million population, 2005 and Growth Rates of Patenting 1997-2004 (Growth Rate of Patent Cooperation Treaty filings at EPO)

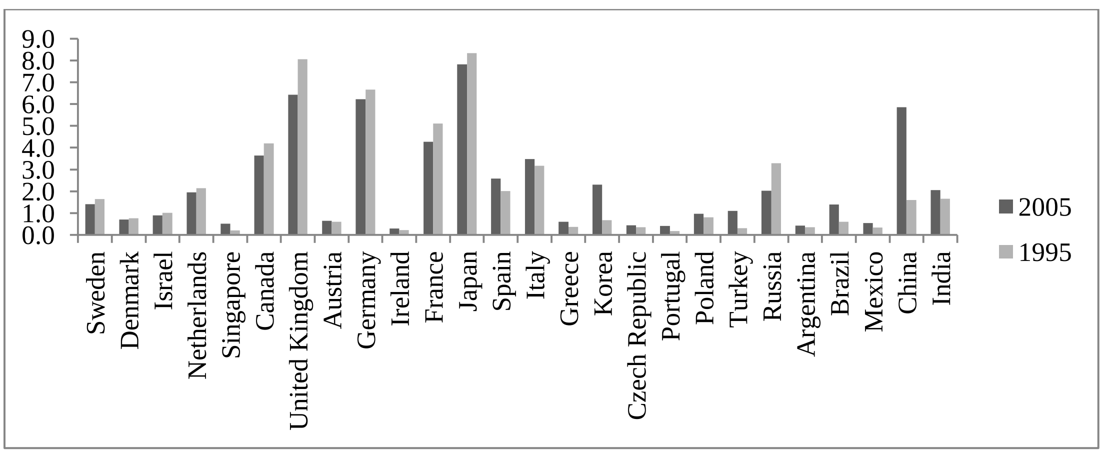
Countries	Triadic Patents 2005	High and Medium High-tech	Medium Low and Low Tech	Growth in Total Patenting – All Industries
Turkey	0.76	0.42	0.21	0.39
Brazil	1.02	0.17	0.15	0.16
Canada	1.94	0.07	0.03	0.06
China	1.42	0.45	0.33	0.44
Czech Republic	1.54	0.17	0.27	0.17
Denmark	2.43	0.09	0.08	0.09
France	2.11	0.04	0.02	0.04
Germany	2.53	0.04	0.02	0.04
Ireland	1.32	0.11	0.06	0.10
Israel	4.65	0.08	0.08	0.08
Italy	1.09	0.05	0.05	0.05
Japan	3.39	0.06	0.05	0.06
Korea	3.23	0.30	0.29	0.30
Netherlands	1.67	0.06	0.05	0.06
Poland	0.56	0.24	0.33	0.25
Russian F.	1.08	0.06	0.04	0.05
South Africa	0.92	0.01	0.00	0.01
Spain	1.20	0.08	0.09	0.08
Sweden	3.73	-0.01	0.00	-0.01
United Kingdom	1.78	0.03	0.01	0.03
United States	2.62	0.03	0.02	0.03
EU-25	1.79	0.04	0.03	0.03
OECD	2.26	0.05	0.03	0.03

Source: OECD Science, Technology and Industry Outlook 2008.

Regarding more direct scientific and technical output measures such as the number of scientific articles per million population and triadic patents, Turkey has also shown significant improvement since mid-1990s in concert with her increasing R&D expenditures. While the patent outcomes remain low relative to EU and OECD countries, annual growth rates of patenting between 1997-2004 in both high and medium high-tech and medium to low-tech industries have been impressive and among the highest in this sample. This is perhaps the most powerful circumstantial evidence that the NIS construction process is beginning to influence technological change and innovation in Turkish public and private institutions.

Finally, the number of scientific articles per million population increased significantly between 1995 (27.8) and 2005 (108.4) as an outcome of basic research supporting science and technology policies in Turkey. While the country was one of the countries contributing less to the total world scientific articles in 1995, it significantly improved its position in 2005.

Figure 5.7 Country % in World Scientific Articles, 2005[41]



This review of science and technology development indicators show that with the adoption of the NIS framework, major indicators showed positive growth trends in line with the objectives of adopted policies and plans in Turkey. However, the advancement in these output measures did not translate into measurable improvements in competitive

[41] USA produced the 28.9 % of total world scientific articles in 2006, dominating all the other country figures. For visual purposes, it is left out of the data for Figure 5.7.

Table 5.4 Scientific Articles per million population and Country Share in WSA, 1995-2005

Countries	Scientific Articles 2005	Scientific Articles 1995	Growth Rate 1995-2005	Country Share in TWSA, 2005	Country Share in TWSA, 1995
Turkey	108.4	27.8	289.8	1.1	0.3
Australia	779.4	721.4	8.0	2.2	2.3
Brazil	53.7	21.6	148.3	1.4	0.6
Canada	800.6	810.2	-1.2	3.6	4.2
China	31.8	7.5	325.2	5.9	1.6
Czech R.	309.7	189.2	63.6	0.4	0.3
Denmark	930.1	827.9	12.3	0.7	0.8
Finland	917.2	798.2	14.9	0.7	0.7
France	482.5	485.5	-0.6	4.3	5.1
Germany	535.3	461.0	16.1	6.2	6.7
Greece	386.4	1,93.5	99.7	0.6	0.4
India	13.3	10.3	29.4	2.1	1.7
Ireland	511.0	338.2	51.1	0.3	0.2
Israel	910.4	1,035.4	-12.1	0.9	1.0
Italy	420.5	314.5	33.7	3.5	3.2
Japan	434.1	375.2	15.7	7.8	8.3
Korea	340.6	84.3	303.9	2.3	0.7
Mexico	37.6	21.3	76.8	0.5	0.3
Netherlands	851.0	782.0	8.8	2.0	2.1
Norway	788.4	670.0	17.7	0.5	0.5
Poland	179.3	118.9	50.9	1.0	0.8
Portugal	275.8	98.7	179.5	0.4	0.2
Russia	100.5	125.9	-20.2	2.0	3.3
S. Africa	51.0	59.6	-14.3	0.3	0.4
Spain	422.5	287.3	47.1	2.6	2.0
Sweden	1108.7	1052.1	5.4	1.4	1.6
Switzerland	1166.4	1019.6	14.4	1.2	1.3
United K.	756.8	784.1	-3.5	6.4	8.1
USA	691.4	725.2	-4.7	28.9	34.2
OECD	**493.3**	**450.4**	9.5	**81.4**	86.9
EU27	**477.4**	**410.3**	16.4	**33.1**	34.7

Source: OECD Science, Technology and Industry Outlook 2008.

position of the country in international markets within the last 10 years[42] as the linkages between research and economic development are highly complex. We must look underneath the aggregate innovation indicators to better understand the specific elements of the NIS contribute or constrain processes of technological change and innovation at the level of industry and firms.

5.2 Building the Institutional Structure and the Systems Perspective

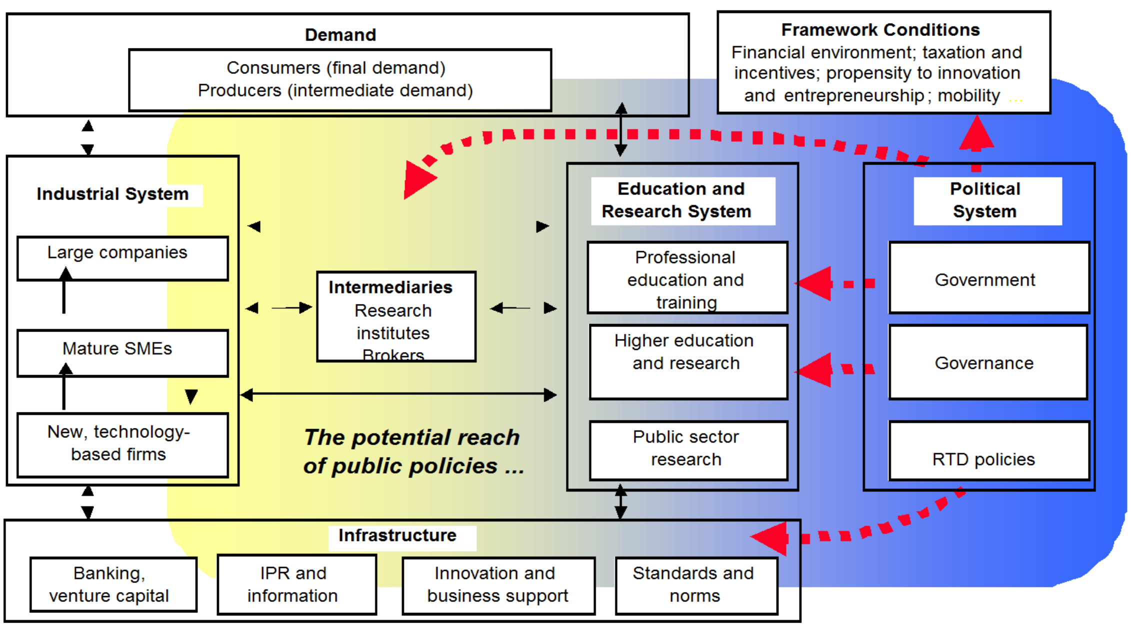
A national innovation system is a set of institutions functioning within the industrial, educational research and political realms of a country which individually and jointly foster the creation, development and diffusion of new knowledge and technologies (Metcalfe 1995; Teubel 1997; Nelson 1993; Lundval 1992; Arnold and Kuhlman 2001). The quality of government policies which provide a framework for all these institutions and the competency of policy makers and implementers shape the rate and direction of technological learning and the innovation process in a country (Patel and Pavitt 1994). The health and performance of an NIS is determined by how well the components of a system are established and the strength and durability of the relations among the elements of the system (Edquist 2005). Having major system actors effectively fulfilling the different needs of a properly functioning system together with national institutions establishing infrastructure and framework conditions are essential during a NIS construction phase.

Turkey's NIS institutional structure at the end of 2000s broadly includes the elements denoted in the above model as a result of the adopted policy initiatives targeting

[42] According to the World Economic Forum's Global Competitiveness Reports, Turkey's historical Global/Growth Competitiveness Rankings among other countries are as follows: 2001(54); 2002 (65); 2003 (65); 2004 (66); 2005 (66); 2006-2007 (58); 2007-2008 (53);2008-2009 (63).

establishment and restructuring of NIS institutions in the 1990s and early 2000s. In the 1990s, several institutions were established and reorganized such as Technology Development Foundation of Turkey (TTGV), the National Metrology Institute (UME), Small and Medium-sized Industry Development Organization (KOSGEB) and TUBITAK-TIDEB (currently known as TUBITAK-TEYDEB a key provider of R&D grants to private firms). In addition various laws were passed including new laws regulating intellectual and industrial property rights and laws designating technology development zones/technoparks. Public research institutions, such as TUBITAK-MAM, were granted more autonomy to support more applied R&D and market oriented product development.

Figure 5.8 NIS Model



Source: Arnold and Kuhlman 2001.

After the mid-2000s, this restructuring process continued with the adoption of additional policies and initiatives targeting interactive relations among system actors. Unfortunately, this process of framework and institution building though necessary, does not guarantee the emergence of well-functioning NIS unless accompanied by a collective understanding of the significance of technological change and innovation among the sectors and actors involved in the system, in particular private firms with limited histories in leveraging technology and knowledge in their business strategies.

Table 5.5 Institutions Influencing Construction of NIS in Turkey

Field of Organization	**Name of Organization**	**Duties and Responsibilities of Organization**
Policy Making	Supreme Council of Science and Technology (BTYK)	Implementation of the Turkish Science Policy and assisting the government in determination of long termed S&T policies, identification of targets, elaboration of plans and programs[43]
	Scientific and Research Council of Turkey- Innovation Monitoring Agency (TUBITAK-TEYDEB)	Administration of direct public R&D and Innovation Funds
	State Planning Organization (DPT)	Advising the government in determining economic, social and cultural policies and targets of the country; preparing long-term development plans (including regional and sectoral plans); developing future-oriented strategies by working closely with international institutions; helping reduce uncertainties in the medium and long term for the private sector by making policy recommendations in cooperation with the private sector[44]
Financing	Under-Secretariat of Foreign Trade (DTM)	Providing grant fund for the private sector projects
	Ministry of Finance (MB)	Providing tax reduction for the R&D expenditures of private firms by a ratio of 40%
	Ministry of Industry and Trade (STB)	Providing funds for SMEs through KOSGEB

[43] Accessed at: http://www.tubitak.gov.tr/sid/1003/pid/547/index.htm

[44] Accessed at: http://mevzuat.dpt.gov.tr/khk/540/spo.html#duties

	Small and Medium Enterprises Development Organization (KOSGEB)	Increasing the competitiveness, effectiveness and scale of Turkish SME's through various support programs such as technology and innovation supports; entrepreneurship development supports; market research and export promotion supports, etc.[45]
	Technology Development Foundation of Turkey (TTGV)	Supporting the development of technological innovation capacity international competitiveness of Turkish industry by participating in the planning process and by providing loan funds for firms and providing financing for start-ups
	Venture Companies	
Business and Entrepreneurship Development/ Support	KOSGEB Technology Development Centers (TEKMERs)	
	KOSGEB Entrepreneurship Development Center	
	Technoparks	
	National Metrology Institute (UME)	Providing software, equipment and prototype production services to industry
Knowledge Institutes	Universities	
	University Research Centers	
	University-Industry Joint Research Centers	
	Public Research Institutes	
	TUBITAK Research Centers	
Intellectual Property	Turkish Patent Institute (TPE)	Responsible for intellectual & property right issues
Innovation Intermediaries	Innovation Relay Centers	IRC-Ege and IRC-Anatolia

[45] Accessed at: http://www.kosgeb.gov.tr/English/index.aspx

5.3 Perceptions of the NIS Construction Process from Public Sector Participants

Based on the formal elements of the NIS in Turkey as shown above, a key aim of this dissertation was to evaluate the process from the perspective of participants in the construction and implementation process. Thirty three participants were interviewed. Interviewees included those working (or in a few cases formerly working) for key institutions in the NIS such as TUBITAK, DPT, DTM, STB, TTGV, KOSGEB, TUBITAK-MAM, TEKMERs, (25) and university research and innovation and technical support and relay centers (8). In general terms, this group of key public sector actors were aware of the NIS concept and described the concept, elements and goals in similar ways and consistent with the way the concept is explained in the literature. The frequent emphasis on the words such as orchestration, harmonization, synergy, collaboration, interaction, linkages and networks revealed that the participants and their organizations were involved in similar sets of discussions with respect to system construction and/or were influenced by similar materials such as OECD and/or World Bank documents on NIS. Many interviewees defined NIS as an entity emerging out of the interactions and collaborations between a number of institutions in education, finance, research and many other policy fields whose activities influence innovative capabilities of firms and research institutions. The general awareness and consistency of views among these multiple actors in regards to the NIS concept was a noteworthy finding of this interview process suggesting that the individual goals of their policies and programs were understood as part of the broad NIS construction project.

The central emphases emerging out of the interviews with respect to the applicability of the NIS concept in Turkey were the challenges of fostering a basic cultural awareness of the importance innovation, of building a systems perspective among program implementers and program clients and of meaningful information sharing and collaboration across bureaucratic boundaries.

In explaining the evolution of NIS, most interviewees emphasized the lack of a history or culture of innovation as the starting point for the development of new policies to enhance the capacity of actors to undertake technology upgrading and innovative activities in Turkey. According to many informants, innovation culture and awareness just started to develop in the mid-1990s as national policy makers and industry leaders recognized that the country had to launch on a new economic strategy in the face of rapid global technological developments and increasing competition from developing countries in lower tech sectors. Firms and institutions needed to amend their strategies and build up their absorptive capacities to efficiently learn new technologies and design new products and processes based on these technologies. The objective of the NIS construction strategy was not only to develop basic and applied R&D capabilities, but also the organizational capabilities that would sustain the adoption and generation of new technologies. A national innovation system in this respect was seen as necessary to help build an innovation culture and awareness across society and within firms in all sectors of the economy. The state was expected to assume a "developmental role" in mobilizing various resources and demonstrating a strong and durable political will to effect a long term cultural change and accomplish stated technological development objectives through a targeted and strategic institution building. One informant emphasized that cultural change was a very long-term and fundamental project beginning with general education and socialization.

> "Creating a sustaining innovation culture within firms starts with establishing this culture within the society and your fundamental means to achieve this objective is your education policy. Even though, it may be seen as extending the scope of the

> NIS discussion, designing an education system where inventions and innovations are emphasized from the early school years determines the quality of your human capital in the future. Turkey, as a country with significant young population, can establish this innovation culture, thinking ability, etc... by getting her young population exposed to this culture as early as possible. Hopefully, educated with these ideals, they will be endowed with the capabilities and skills to start new innovative businesses in the future, or blend in an organization culture where innovation is the main motive for making profits". (Interview with one of the ex-directors of TUBITAK-MAM).

However, a number of interviewees stressed the core challenge as changing the culture, and building essential awareness and capabilities within private firms. As noted, technical change and innovation in Turkey has historically been centered in a relatively small number of large firms. And unlike Ireland, for example, the level of foreign direct investment (FDI) in Turkey has been low and opportunities for technology transfer from international firms have been relatively limited. Informants emphasized that a crucial challenge in NIS construction is changing the awareness and competitive practices of firms in most segments of the economy.

> "For a well functioning national innovation system in a developing country context, you have to start the process with an innovation awareness rising movement among the firms. Developing new technologies, searching new markets for these new products necessitates a bundle of skills on the part of the firms. Firms should be willing to create new knowledge, they should be willing to reach for knowledge that will generate increased value-added, (a significant problem of Turkish consumer products industry), and they should be willing to hire new talent and invest on this new talent".

> "In a developing country context, you can't expect all of this emerging out of nothing. You have to teach firms, you have to persuade firms that they have to increase their productivity, efficiency and effectiveness through better technologies and increased learning capabilities. You have to teach them how and why to make R&D: design, project implementation etc. You have to teach them about the importance of marketing. You have to encourage them to invest in technology intensive areas of activities. In Istanbul, there is an exceptional culture of entrepreneurship. Firms can find and access various sources of money, investment, etc. However, as they don't know have the expertise in technology intensive production, they invest in other areas. The national innovation system

should be arranged in a dynamic way to accelerate the sources to reach out to these firms and nourish their capabilities through existing science and technology sources of the country including universities and research centers...” (Interview with a coordinator at TTGV-Istanbul)

“Creating an innovation culture within the firms is not an easy process. My 30-year experience in Turkish bureaucracy taught me that in a developing country technology based growth takes time. It is evolutionary. Even though, you want this to be revolutionary, invasive, happening real quickly, it is not possible. At least it is not possible through the mediums that have been adopted until so far in Turkey. Not that I’m saying nothing has been done to create this innovation culture within the firms, many things have been done of course, such as allocating R&D loans and grants to firms starting mid- 1990s, but these were insufficient to generate the expected impact as they were not backed up by a strong political will that put technology based economic growth at the core of everything” (Interview with an ex-policy maker in TUBITAK).

Another general theme from the informants in terms of the NIS construction process was the ongoing challenge of coordination and communication between institutions and actors in the system. Systemic-identity awareness was mentioned with respect to how system actors define their role in a functioning NIS and how their bureaucratic culture permits collaboration with other organizations especially with respect to reorganization of existing programs and needs. The lack of a performance or outcome based culture in the public sector and the lack of systems perspective on technology related problem identification and solutions were seen as significant ongoing barriers to the evolution of the NIS in Turkey.

“When you look at the actors involved in national innovation system of Turkey, you see that every institution that has some importance for Turkey is included in that structure and identified as crucial for the system. However, it should be simpler. It should be simpler because the system itself is so complex that its design requires some creative thought and action unique to Turkish context. It should be operable, dynamic and designed to accomplish the expected targets. This does not mean that some actors whose main field of interest is highly technical are unimportant. But, if you believe in their importance for the system and define them as one of the major components of the system, then you ought to make sure that these institutions understand this as well and contribute to system construction process and influence the development and diffusion of innovations". (Interview with a manager in TTGV-Ankara)

> "We have all the actors but we cannot make them work together. This is maybe because we do not believe in institutions without concrete structures, working in harmony in a systems perspective such as national innovation systems. Systems perspective brings in newly defined roles, responsibilities and contributions for actors. Systemic collaborations introduce new division of labor among institutions and stimulate different activities to fulfill new needs and demands. In Turkey, most NIS actors are not ready to adopt and embrace new roles and responsibilities as most of the innovation based milestones are introduced by international treaties or frameworks". (Interview with a technology expert in TTGV-Istanbul)

> "[The] innovation system of Turkey includes too many actors who do not communicate or who do communicate but in limited terms. Yet, you still want to believe that their existence will generate the desired interactivity and collaboration, and this collaboration will generate the expected outcomes. Unfortunately, this doesn't happen automatically. The invention-to-innovation transition is a complex process and necessitates simultaneous and active involvement of many institutions such as technologically mature private firms, university research centers, technology commercialization offices, etc. Not only the existence but also the excellence of them is essential. In Turkey, we need creative policy makers working on policies that encourage collaboration and effective communication among universities, research centers, venture capitals, etc that challenge the sustaining organizational cultures with respect to the breadth and frequency of interactions." (Interview with a science and technology planner in DPT).

Fragmentation and institutional insularity among NIS elements are not uncommon in very high income innovative countries, but in a developing country such as Turkey with a very short history of coherent technology development policies, a "habitis" of collaboration and cooperation may be particularly hard to develop. The establishment and rapid evolution of technology adoption and innovation practices is dependent on how countries can successfully design and implement programs that encourage co-evolution and collective learning among innovation system actors. The fact that interviewees were honest and sober in their assessments of the degree of collaboration and harmonization among key institutions may be a relatively positive indicator that actors recognize the need for better communication and joint effort. The expected outcome, especially during the early phases of system building, is that the NIS idea and policy mix will ignite "system effects" which will make actors recognize the cumulative benefits of harmoniously functioning and adopting organizational strategies that will support transformative system objectives.

5.4. General Framework of Policies and Programs Targeting Innovations

Innovation policies and programs targeting NIS development in developing countries focus both on mobilizing resources and promoting change by developing learning capabilities of multiple institutions. The constructive process involves the design of a context-specific system which not only encourages firms to conduct R&D through increased resources such as talent and capital investment but also encourages firms to establish new relationships that improve their capacity to learn about new technology and market opportunities[46].

The existing policy mix in Turkey which has been developed since the early 1990s focuses on four main categories: (1) increasing the rates of expenditure on R&D and technological innovation in private enterprises, (2) intensifying R&D cooperation among public research institutes; universities; and enterprises (3) increasing the number

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[46] A dynamic approach to adaptive policies and programs supporting the invention--innovation--growth model also demands inclusion of certain industrial policies to track global innovation trajectories and business models to facilitate domestic firm's integration into global value chains (Auerswald and Branscomb 2008). As articulated by the new developmental state theories, nation states can influence their developmental patterns and competitiveness through some structures which provide necessary support for their private enterprises to become part of globally networked innovation networks (O'Rien 2004, Breznitz 2005). The competitiveness objectives of the countries thus becomes not only an issue of how well the policies and programs promote the internal interconnectivity of institutions forming NISs, but also how well NISs, as dynamic instruments, as parts of clearly defined industrial policies that position its business sectors for new technologies and for global markets.

of new innovation intensive enterprises (science and technology based start-ups) created and increase their survival rates, and (4) increasing the direct commercialization of knowledge created by public research institutes and universities (INNO-Policy Trend Chart Turkey, 2009). Until 2006, technology and innovation policies mostly emphasized the first two categories, and since then the policy mix has been amended by a greater emphasis on the last two categories.

These categories of policies mostly touch upon the major activities in an innovation system such as provision of knowledge inputs to the innovation process through encouraging creation of new knowledge in technical fields and the buildup of human capital and talent; encouraging entrepreneurship and creation of new science and technology based enterprises; provision of new interactive learning through networking between knowledge institutions and enterprises; provision of financing and consulting on innovative activities and marketing and commercialization activities. Most of these activities when translated into major taxonomy of innovation policies emphasize supply-side measures which seek to reduce the cost of acquiring knowledge, technology and marketing expertise versus demand-side measures such as market creating regulation or government procurement (Georghiou 2003, 2006). In what follows, the specific NIS policies and programs established over past 15 years will be reviewed from the perspective of those involved in the implementation and management of the programs. These program areas can be viewed as subcomponents of the emerging NIS in Turkey and I questioned the key factors associated with each program area about the objectives, challenges and successes in their areas.

Figure 5.9 Policy Measures According to Start Date in the NIS

Institutions	Before 1995	1995-2004	2005-2010
TUBITAK	The Support Program for Scientific and Technological (Academic) Research Projects	The Support Program for Industrial R&D Projects (GRANT);	Patent Application Promotion and Support Program; Techno-Entrepreneurship Funding Program; Support Program for First R&D Projects of SMEs; Support Program to Build Scientific and Technological Cooperation Networks and Platforms; Rapid Support Program; Support Program for Research Projects of Public Institutions; Global Researcher Support Program; The Participation Program for International Scientific Research Projects; National Young Researcher Career Development Program; Support Program for Project Brokerage Events; Support Program for International Industry R&D Projects; Support Program for National Aerospace Research; Support Program for National Defense Research Projects;
TTGV		Technology Development Support Program (LOAN);	Commercialization Project Supports; Joint Technology Development Projects; Environmental Project Support Programs; Risk Sharing Facility Support; Start-up Support; Pre-incubation Support Program;
KOSGEB	Research and Development and Technological Innovation Support Program; Establishment of Technology Development Centers (TEKMERS); Consultancy Support for SMEs;	Training Support (General and Special); Industrial Property Rights Support; Young Entrepreneur Development Program; Machinery Equipment Support for Common Use by SMEs; Software Support; Supports for Hiring Qualified Personnel by SMEs; New Entrepreneur Support; Consultancy Support for SMEs; General Entrepreneurship Training; Quality Development; Market Research and Improvement of Export;	Electronic Signature Support; E-commerce Support;

MoIT		Law on the Establishment of Technology Development Zones (Technoparks);	Industrial Thesis Projects; Patenting Support Program; Industrial R&D Investment Support Program; Industrial R&D Products Marketing Support Program;
Ministry of Finance			R&D Tax Exemption

5.4.1 Supply-Side Finance Measures

5.4.1.1 Grants and Loans for Industrial R&D

During the system construction process, public grants for industrial R&D played an important role in stimulating the research and technological adoption capabilities of private enterprises. In Turkey, TUBITAK-TEYDEB has managed the Support Program for Industrial R&D projects since 1995. The program was launched as a result of the strong efforts of TUBITAK officials who were concerned about the technological capabilities and technology based growth potentials of the country. However, the Undersecretary of Foreign Trade (DTM), was the actual funder of the program, and viewed it through a distinctly different lens. DTM saw the grants as a means to promote and subsidize exports after direct export subsidies were banned by GATT trade agreements. An ex DTM official was quite explicit about the objectives of this grant funding in the earlier years.

> "When we first established the TIDEB (currently known as TEYDEB), we were not mainly interested in developing technological or research capabilities of the firms. Bounded by international demands on export subsidy elimination, we just wanted continue to distribute money to firms via different instruments. We wanted to support firms but we couldn't do it explicitly and we used R&D support to replace our export subsidies. Our objective was pretty much the same: to increase exports of the country through the provision of subsidies. If new subsidies could increase the technological capabilities of the firms, this would be an additional gain for the country" (Interview with an ex-policy maker YM).

DTM's position on exports was actually another manifestation of export promotion policies linked to a strategy of devaluations and export incentives with little investment in productive infrastructure improvements. Starting in 2005, the funding of the program increased significantly and is now mostly financed (75%) from the TUBITAK's own resources (from the national budget). This funding switch increased overall funding and sharpened the focus on industrial R&D and firm innovation, but placed considerable stress on policy makers with respect to program implementation.

> "Until recently, TUBITAK which usually had limited resources had the ritual of asking for more money from the government. We explained them why we need to invest on technology, why we need to build on our capabilities, why we need to innovate, etc. This was a ritual for us. However, when the government actually decided to allocate more money to R&D, we suddenly realized that we really don't know what to do with this big chunk of money. This increased the pressure on us because the government had cut the budget of the National Intelligence Organization and increased the OTV (private consumption tax) 1 % to generate the extra amount. We had to be successful as this was coming with an opportunity cost and we had to generate the expected outcomes to assure the sustainability of the funds. And the safest bet for us was to continue on what we were doing. We supported each and every project application (obviously the proper ones) without any selectivity" (Interview with a specialist in TUBITAK-TEYDEB).

TEYDEB's R&D support program is a horizontal program (direct support of all services and technologies) serving mainly for two purposes: (1) to reduce the R&D cost of firms and increase their R&D efficiency; and (2) to increase the internal investment by firms in R&D activities. Regarding the implementation of the program, it is the largest funded program influencing technological behaviors of firms. Research projects are supported up to 3 years with the condition that the amount of support provided cannot exceed 60 % of the total R&D costs (including labor, material and machinery, training, external expertise, patenting, etc.). To encourage private sector spending a private match from the firm must be at least 40%. The increased program resources, accompanied by promoting and raising awareness about technology and innovation, caused a surge in the number of project proposals from 260 in 2000 to 809 in 2007. The number of proposed projects that were awarded grants rose from 180 in 2000 to 566 in 2007. In monetary terms, TEYDEB support for R&D was $19.7 million in 2000 while private sector's contribution was $71.7 million. These amounts reached $128.1 million and $199.4 million respectively in 2006, reflecting an increased commitment to R&D activities on the side of the firms. In terms of accelerating public investment and leveraging private investment in R&D, this grant program can be viewed as successful.

Unfortunately, the real impact of the program is unknown due to lack of structured evaluation and monitoring assessments[47].

> "The structured evaluation of the program take-off does not exist for the R&D support program. However, based on our interviews with firms, we know that grants are increasing their interest and changing their behavior towards product development. We can say that firms are not only "learning" to develop new capabilities but they are "learning" to apply for available R&D grants. They are becoming more aware of the existing opportunities. As they become more competent and get more involved in the process, their grant applications will increase. Our objective is to reach to a wide range of new firms and persuade them to develop products and processes that help to reduce the import dependency of the country."(Interview with a policy maker in TUBITAK).

> "Under the TIDEB Program (currently known as TEYDEB) more than $300 million was spent on R&D activities between 1995-2000 and we just don't know what kind of an impact it did create on the developing NIS. The political authority interprets NIS as a black-box. It pours money in, something happens inside but you don't know what. What is the outcome of the system? We need to conduct studies that not only evaluate impacts of the implementation programs but also studies that illuminate operation of the system identifying its failures. This is the only way we can transform support programs according to the needs of the whole system". (Interview with a specialist working on technology and innovation policies in TUBITAK).

[47] The importance of evaluation and monitoring techniques on program assessment is acknowledged and efforts are started to investigate international experiences.

The program prioritizes and encourages technology and product development in small companies; hiring of highly educated researchers; collaboration with universities and research centers; and development of certain technologies by providing additional support incentives in certain product areas. However the broader transformative impacts of this program are seriously questioned by many actors.

> "An important question that should be addressed is who benefits most from the current innovation system in Turkey? For me, it is the institutions including private firms which know what kind of support structures exist and how they can benefit from them. They are the "users" of the system. Many firms, especially SMEs, apply to these programs to get some in monetary or in-kind support. They certainly are "aware" of the system. However, their participation in these programs does not mean that they are aware of the benefits of innovation-based growth or that they know what they "need" to achieve their objectives. Support programs, maybe together with other programs, should turn these firms into "producers" of the system by treating them as players in a targeted industrial policy. At this point, this is the only way you can transform the existing "system awareness'" of many firms into "innovation awareness" (Interview with a specialist working on industry support programs in ASO).

Major criticisms of firms and policy experts with respect to implementation of the program focus on a wide range of issues including the non-selective/non-targeted nature of the project assessment process (firm type, sector, industry technology status and opportunities, etc); complex and tedious application procedures for firms; long project assessment timeframes; lack of support on capital/construction expenditures tied to innovations; long disbursement times and lack of serious evaluation (especially concerning success in marketing improved or improved products linked to the grants). While some of these issues can be addressed through minor to major policy justifications such as timing and access, others need major modifications on program design. There was, in particular, serious questioning of the horizontal nature of the program and its lack of connection to specific industrial or technology development policies among current and former officials and program managers.

> "Unfortunately, innovation has always been perceived as equivalent to science and technology in Turkey. The current science and technology emphasis in the system makes the system more like "science and technology management system" instead of NIS as there is no coordination between science, technology and industry policies. In other words, science and technology has always been considered as an "objective" without articulating its connections with industry and actual innovation. Science and technology is actually an "instrument". The prioritized science and technology fields in the major plans and policies could not be achieved as their connections with the industry could not be established. Consequently, due to lack of industrial guidance, the support programs carried out by State Planning Organization (DPT) and TUBITAK have adopted a bottom-up approach, structured around the quality of the suggested project proposals. Existing capabilities and accumulated knowledge in the institutions in this way have determined the path of growth and competitiveness of the country (the lock-in effect). Even though project assessments pay attention to projects targeting prioritized technology areas, through the adopted approach in support programs, it is highly unlikely to expect to achieve the socio-economic development objectives of the country" (Interview with a specialist working on science and technology policies in DPT).

> "Programs supporting project development and R&D capabilities of firms are mainly horizontal and show no sectoral, technological or regional selectivity in Turkey. There are basically four types of firms that receive R&D support: (1) firms that need technology just to meet basic needs of their customers; (2) firms that are interested in technology development but not enough to change their organizational routines; (3) firms that are aware of global technologies and working in that direction; and (4) firms that develop globally competitive products and technologies. Obviously, needs and contributions of these firms are very different from each other. Yet, existing support programs treat these firms as if they are same through their generic support mechanisms. Policies and programs need restructuring according to relevant technology typologies, as identified in Vision 2023 foresight document, not only to generate advancement in targeted technologies but also to initiate "learning" about the firms working on similar and different technologies." (Interview with a manager in TTGV-Ankara).

> "You know that you have some firms in your country that design robots that are new to the world. You also know that some firms in your country develop products that have been widely used in world for almost 20 years. And you

> consider both types of these firms as innovative and support their product development and innovation processes through the same generic means. Turkey needs to restructure its institutions according to technology typologies and say for instance that TTGV and TUBITAK will no longer support similar firms. TUBITAK will focus on high-tech firms and TTGV will deal with the rest, etc.; or will establish/develop new institutions or entities that focus on different technology typologies, etc" (Interview with a technology monitoring expert in TUBITAK-TEYDEB).

There were also a number of comments on the cumbersome and time consuming process of grant applications and funding decisions.

> "Project assessments take long time, usually between seven to twelve months and that is true. This is mostly because the assessment process follows particular steps. Once the project proposal is received, it is sent to the related technology group[48] and a technology expert is assigned to each project. Meanwhile, three academics usually from different universities are assigned to individually assess the eligibility of the project. Their assessment goes on another round of evaluation at the sectoral boards and final decision on support is made here in these boards. The decision on support does not come with the disbursement of funds though. Firms continue on their research activities with their own resources. This is OK if firms had enough resources or already working on projects that are somehow generating money. However, if the success of the project depends on TEYDEB payments; if they had given monetary promises to other parties depending on the scheduled disbursements, they're in trouble. Payments are usually made 6 months later than the affirmed date and firms usually have to look for other resources to meet their expenses. Things get worse for firms if their innovative activities necessitate some capital investment because TEYDEB does not assess the associated construction costs as part of the eligible R&D costs, reflecting the need for another important alignment between the innovation and industry policies" (Interview with a technology monitoring expert in TUBITAK-TEYDEB).

Besides TUBITAK, TTGV is the next most important institution which has supported and advanced the R&D financing and innovation assistance in Turkey. Until very recently, Technology Development Support Program was the main support program

[48] There are 5 technology groups in TEYDEB: (1) Machinery and Manufacturing, (2) Electrical and electronics, (3) Material, Metallurgical and Chemical, (4) Biotechnology, Agricultural, Environmental and Food, (5) Information Technologies.

of TTGV, which was launched under the framework of World Bank's Technology Development Project-I (1990-97). This program provided \$170 million to 480 manufacturing and software projects in the form of soft loans. Starting in 1995, TTGV started to support private sector R&D projects with additional DTM funds. Between 1996 and 2007, TTGV supported 254 firms with \$86.2 million (DTM funds) with the main objective of increasing the R&D capacity in the private sector.

The Technology Development Support Program is very similar to TEYDEB's R&D support program with respect to the objectives and implementation of the program, assessment of projects, defined eligible costs[49], and upper limit of total R&D costs supported etc. The only difference is the mode of finance and the currency of the support. While TEYDEB offers grants, TTGV provides soft loans which were preferred to bank loans, especially when the inflation rate was high in the country. TTGV also provides loans in US \$ currency in order to protect itself from macroeconomic instabilities and this (getting credits in another currency) is usually evaluated as high-risk by firms, impeding their undertaking of more risky but rewarding projects (Correa et.al 2008:78).

Until a few years ago, critics of the Technology Development Support Program focused on the program's resemblance to the TEYDEB and for supporting the same base of firms funded through TUBITAK. TTGV was also criticized for not reaching out to young, high-tech companies which were usually unable to provide the collateral asked as a guarantee for the loans. TTGV, to better serve the identified needs, extended its program portfolio and adopted support programs targeting underfunded areas of the innovation policy such as start-up support, risk-sharing facility support, pre-incubation support, commercialization project support and environmental project support.

[49] Construction and overhead costs related to R&D activities are not eligible for support in TTGV as well.

> “We’re aware that economic value-add of the traditional support program [Technology Development Support Program] is very low. When you use the resources of other institutions [DTM] you’re obliged to follow certain principles and it’s pretty difficult to create your own niche in the system. TEYDEB supports projects up to 60 % of their eligible R&D costs, TTGV supports up to 50 %, neither of the programs encourage rapid growth of idea based, small high-tech firms because TTGV asks for collateral and TEYDEB lack the means to address the needs of these innovative firms such as commercialization, risk-sharing, etc. Therefore, we have developed new programs through TTGV’s own resources (which make up almost 25 % of its total resources) to support people with really good ideas or small high-tech firms endowed with high qualities but limited resources to accomplish their objectives (Interview with a technology expert in TTGV-Istanbul).

> “We really wanted to bring in an additional value to the innovation system in Turkey. We thought about the missing but needed innovation support instruments and asked two basic questions: 1) what would happen if we didn’t provide the funding through our own resources but searched for resources from other institutions? 2) would the system generate similar programs if we didn’t invest in these areas? After careful consideration we decided that TTGV should restructure itself and support more risky plans and areas” (Interview with a manager in TTGV-Ankara).

The new programs launched in 2006 were quite small and only a few projects were funded at the time of this study. In 2008, $2.8 million was allocated to commercialization support, and $2.5 million to joint technology development between universities, research centers and private firms. Only one project was supported under the pre-incubation support program and three under the start-up support program. These programs continue to develop and they do suggest that TTGV’s adapted its policies and programs to meet needs in the less supported and more risky areas of incubation and small firm R&D projects[50].

[50] TTGV’s newly identified support areas initiated adoption of similar programs by TUBITAK in 2007.

5.4.1.2 Supports for Public Sector Research Institutions and Training and Mobility Initiatives

Support for public sector research, training and mobility are also important dimensions of supply-side measures to promote technology development and innovation. Public sector research institutions have positive externalities that, among other things, lower the costs of knowledge acquisition and technology adoption for private firms. Training of managers and workers is likewise justified on externality grounds and it lowers the cost of knowledge and skill acquisition that benefit both the individuals trained and their co-workers (through transfer of skill and knowledge). The State Planning Organization (DPT) is the primary agency providing funds to public research institutions, including universities in Turkey. DPT determines the budget allocations of the major investment projects of public organizations through meetings and consultations with the government to coordinate public sector investment decisions with national development plans. Administration of the national R&D budget in this respect lies within the responsibility of DPT. In 2008, DPT allocated approximately $131.6 million to universities and $48.7 million to TUBITAK research centers for R&D investments.

DPT's adopted investment model formally follows a bottom up approach as it calls for project proposals from ministries, universities and other institutions. It then evaluates proposals according to their impact on national socio-economic development. Specifically, DPT prioritizes projects that contribute to the achievement of targets articulated in the national development plans. Due to lack of connection between industrial and innovation policies, its role is more an allocator of resources than an active planner and developer of priority technologies for industrial development as is the case in Taiwan or Israel. (Breznitz 2005, Kennedy 1989).

As the priorities in NIS construction started to become clearer among various institutions, DPT's project based approach has evolved into more of a program based approach. Human capital development and establishment of R&D infrastructures supporting collaborative relations between public and private sector organizations became the main objectives of DPT support. DPT supported collaborative research projects between the public and private sector in identified priority fields to improve capabilities. Together with a major technical university, DPT started the YUUP Program (Extended National and International Projects) to identify similar R&D efforts and capabilities in different universities and firms and to encourage specific collaborations based on capabilities and needs. DPT also launched the "advanced research and education program", which supported graduate students during their research studies and also the "industrial doctorate program" which promoted joint research and support between universities and their doctoral students and the private sector.

Through all these programs DPT emphasized in its policies and directives that, that given the limited resources of the country, project depended upon effective collaborations to attain the latest technologies in priority areas. As major centers of basic science and applied research, universities should play a lead role in this process; organizing and efficiently utilizing their infrastructure and enhancing human capital-- and research capacities in less developed institutions.

> "These projects are more like need - matchmaking projects. Two groups of universities exist in Turkey. The first groups are the ones that are high quality, endowed with good resources, infrastructure, faculty and researchers. The other group is newly developing universities. There are capable researchers in the new, periphery universities who have been funded during their doctorate studies in international universities with the condition to come back and work in these new universities. So, there is research capacity in these institutions but a limited research infrastructure. With these projects, we wanted to assure that researchers in new universities can access the resources of the best technical universities

while working on the problems of the industry or institutional partner. The projects funded in this area are usually small scale, basic and applied research projects. The type of interaction between the partners depends on the nature of the project. Sometimes, the project outcomes directly transferred to the industry partner and sometimes services are provided by the industry as in the case of production of prototypes. With these projects, we try to initiate collaboration between university and industry. However, how much these projects are contributing the competitiveness of private companies is another question and definitely should be assessed as these projects mature." (Interview with a science and technology specialist in DPT).

"These selected projects are among the proposed projects that happen to be generally in a priority technology area. So, selection is bottom-up. You're not calling for specific projects in specific priority areas. Currently, which option is better for Turkey, I'm not sure as we don't have an industrial policy fostering development of specific technologies in accordance with developments in global markets. Without such expertise, targeting specific technologies might be more problematic in terms of allocation and utilization of limited resources." (Interview with an industry specialist in DPT).

The Small and Medium Industry Development Organization (KOSGEB) and Ministry of Industry and Trade, are the two other important institutions that provide support for training and mobility in private firms via supply-side measures in the Turkish NIS. KOSGEB was established in 1990 with the objective of enhancing the low competitive capacity and slow technology adaption processes in the SMEs. Its programs support smaller firms with limited internal resources with a wide range of services. KOSGEB provides a hiring subsidy to SMEs' to "hire qualified personnel" that are either university or vocational high school graduates to improve the performance and technical capacity of small firms. Between 2003 and 2006, KOSGEB granted $29 million to hire 4,680 graduates with the Supports for Hiring Qualified Personnel Program. The upper limit of the hiring subsidy was a onetime payment of $14,000 for university graduates and $9,500 for vocational high school graduates for a duration of 18 months.

KOSGEB also finances the general and specialized training of SME managers and technical personnel the necessary hard and soft skills to adopt and apply new technologies. The upper limit of finance provided is around $5,000 per company per year for this special training program. For general training the upper limit varies according to the development level of the region where the SME is located. Between 2003 and 2006, 19,392 general projects were financed with approximately by $4.6 million dollars in funding.

KOSGEB also provides more structured entrepreneurship training and consultancy support for SMEs. Entrepreneurship training is targeted for entrepreneurs planning to apply for “new entrepreneur support program” which aims to financially support growing entrepreneur-based enterprises. Between 2003 and 2006, KOSGEB allocated almost $3 million to 516 firms as part of its “new entrepreneur support program”.

As part of its training and mobility measures, KOSGEB through its “quality development program” provided grants to firms to support product certification, testing, analysis, audits and CE marking costs[51]. Industrial Property Rights protection of SMEs (the IPR program) is also promoted through financial support for patents, useful model and industrial design applications. Roughly 77 projects received $72,417 under the IPR support program between 2003 and 2006. KOSGEB’s “market research and improvement of export program” also provided grants to SMEs to participate in national and international fairs that are considered important sources of market knowledge for their new product development activities. Between 2003 and 2006, approximately $6 million was granted to 754 firms in this program.

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[51] The **CE** marking certifies that a product is in congruence with the EU consumer safety, health or environmental requirements.

In sum KOSGEB offers a wide range of services and focuses on niches where there is significant need and where other parts of the NIS are not strongly focused (especially in the area of training and technical assistance to SMEs). Unfortunately, specific outcomes in terms of improved product development and marketing are not known, due to lack of systematic program evaluation and monitoring. Most generally despite the diverse services offered the impacts of these grants, financing and technical assistance efforts in transforming the low-technical capacity of Turkish industry according to the targets set in major policy and planning documents is unclear.

> "The major approach with respect to technology and innovation support in Turkey is "doing more of the same". Programs, after careful assessments and evaluations, should be differentiated according to the specialties of major institutions. KOSGEB, for instance, as an industry oriented organization, should develop programs that structurally challenge the existing low-tech formations in line with the industrial policy. Other institutions should confront the existing culture on technology in the society. The pace of change in your technological capacity should not depend on existing pace of change in the culture of innovation in your society. Institutions should collectively challenge this and reassess their contributions in the system." (Interview with an administrator in KOSGEB)

The Ministry of Industry and Trade (MoIT), other than financing support programs of its affiliate KOSGEB, has not been heavily involved in technology and innovation policies and programs until very recently. However, MoIT created the San-Tez program in 2006 and started to appear as an actor in research and technology development related discussions. It views its role as supplementing the work of TUBITAK in promoting new and more effective collaborations between universities and private industry. The San-Tez program was designed to bridge the gap between industry and university cultures in order to increase the low technology absorption capacities of private firms by establishing new venues for communication and cooperation.

> "There is a huge knowledge gap between the universities and industry in Turkey and we wanted to establish a program that would ease the flow of accumulated knowledge in universities to private firms. The program started with couple of different intentions. The first one was to contribute to development of a "common language" between universities and the firms. Because of their different capabilities, in general, both the universities and the industry are reluctant to approach each other. Firms, unfortunately, treat universities like engineering design companies. They tend to approach universities when they have a problem, or are in need of consultation services, etc. They don't see the benefit of carrying out joint projects that would improve the level of their productivity, product development capabilities, etc. Firms criticize universities for being too slow, not understanding the connection between money and time, etc. Universities, on the other hand, condemn the low technological development in firms and usually see no value in collaboration that would have little-impact on the quality of their ongoing research. So, we wanted to provide incentives to bring them together, to start communication. Second, we wanted to transform the basic graduate level research to focus more on innovative products with commercialization potential. And third, we wanted to create relationships between graduate students and the firms to extend future hiring opportunities. With these intentions, we started calling for joint project proposals, conditioning private firm financing 25 percent of the total project budget [Firms match 25% of total project costs]" (Interview with a San-Tez official in MoIT).

No evaluation with respect to the program implementation or success is available yet, but $10 million was allocated from the budget in 2007 for San-Tez projects and 111 projects were supported in 2008 as part of the Program. MoIT's involvement in R&D related activities was increased in 2007 with the Law on the Amendment of MoIT's Organization and Tasks. This law allowed the ministry to design new support programs targeting to the R&D and innovation capabilities of the private firms.

5.4.1.3 Fiscal Measures and Equity Support

The new R&D Law which was enacted in February 2008, together with the Law on Technology Development Zones (TDZ), created a new and expanded framework for tax incentives and other fiscal R&D subsidies in Turkey. The new R&D law, the details of which are outlined given in Table 5.6 profiles tax incentives for private firms conducting R&D activities and is especially important for private firms which are located outside of a technopark development. Firms located in a technoparks were also granted a range of incentives with the Law on TDZs.

Table 5.6 Main Features of the New R&D Law

Features		Identified Issues
R&D discount (volume of R&D)	100% of R&D and innovation expenditures made by technology centers' enterprises, by R&D centers, in R&D or innovation projects supported by public administrations or international funds, is discounted in the calculation of corporate earnings	Big companies with over 50 full time R&D personnel can benefit from incentives. For SMEs, companies getting support from TUBITAK, 'TTGV and KOSGEB (and Intl agencies) are eligible.
R&D discount (Increment of R&D)	Half the amount of increase compared to previous year in R&D and innovation expenditures made by R&D centers which employ more than 500 full time equivalent R&D personnel is discounted (in addition to 100% of R&D expenditures) in the calculation of corporate earnings	Large companies with over 500 R&D personnel can use the incentive.
Tax exemption for R&D personnel	The income tax of R&D and support personnel working for technology centers' enterprises, in R&D centers and for R&D and innovation projects which are supported by public administrations or international organizations or for those projects which are carried out by TUBITAK, those working in pre-competitive research projects and in those enterprises benefiting from Technopreneurship capital support will not be paid at a rate of 90% for those with doctorate degrees and 80% for others.	Large companies with over 50 R&D personnel can benefit directly from incentives for SMEs, only those getting support from TUBITAK, TTGV and KOGEB (and Intl agencies) are eligible.
Social security payments for R&D personnel	Half the amount of social security payments which is required to be paid by the employer of R&D personnel working for technology centers' enterprises, in R&D centers and for R&D and innovation projects supported by public administrations or international organizations, or implemented by	Large companies with over 50 R&D personnel can use the incentives directly. For SMEs companies getting support from TUBITAK, TTGV and KOSGEB (and Intl agencies) are eligible.

	TUBITAK will be covered by the Ministry of Finance for five years.	
Stamp tax exemption	Any documents to be prepared for R&D and innovation activities within the framework of this law shall be exempt from stamp tax.	
Technopreneurship support	Public administrations can provide one time Technopreneurship capital support up to TRY 100,000 without collateral.	Only recent university graduates can benefit from the support.
Pre-competitive research	Budgets created for pre-competitive projects will not be treated as income for the partner organization holding the special account on behalf of the other partners	
Tax exemption for R&D incentives	Grant support provided for R&D activities of companies will not be considered as income if kept in a special fund.	

Source: Correa et.al 2008, pp.108

Lack of equity finance support is often identified as “one of the weakest links” of the Turkish innovation system. Innovation finance from venture capital (VC) and business angels is very limited in Turkey. Public financial incentives have not been designed to promote VC investments. There is no public VC program as in other countries, such as Israel, which significantly influenced rapid innovation in its IT sector (Teubal 2002). There are only three VC funds with public sector participation in Turkey, and the total fund size for VC and private equity (PE) funds is only around 400 million dollars[52] (Correa et.al, 2008). The existing VC support misses early stage funding and tends to be more oriented to support of second and third stages of low-tech investments.

> “There is no real venture capital mechanism supporting high-risk, early and first stage, technology-intense projects in Turkey. However, the problem is not unique to technology-intense sectors. . Unfortunately, VC is very limited, and Business Angels are almost nonexistent. The existing VCs are not supporting technology-based small firms as due diligence is an expensive process and justified for big investments. One successful VC investment was UNO-Bread. Investment in a

[52] TTGV is a partner in two VC funds (Is-Girisim and Turkven) and in a Start-Up fund (Teknoloji Yatirim A.S.)

bread company is actually tragicomic in a country where flour factories in almost every city are working with idle capacity." (Interview with a technology expert in TTGV-Istanbul).

5.4.2 Policies and Programs to Foster Collaboration and Networking

The systemic perspective of NIS construction demands first and foremost strong collaborations between institutions on the development and commercialization of technologically advanced, innovative products, diffusion of which is expected to increase the competitive position of Turkish industry. Policies and programs directed to facilitate collaborations and networking mostly involve direct and indirect measures to increase and deepen collaborations between public sector institutions and private firms some of these were highlighted in the previous sections when programs and program managers' perspectives were analyzed such as the TUBITAK-TEYDEB TTGV R&D support programs, MoIT San-Tez program, etc. During the last couple of years, other programs supporting joint research projects of public institutions and the defense industry (KAMAG and SAVTAG) and cooperative networks including pre-competitive cooperation among firms were developed foster collaboration.

An additional noteworthy set of initiatives involve geographically defined technology development and incubation centers such as technoparks, the principles of which are determined by Technology Development Zones (TDZ) law, technology development centers (KOSGEB-TEKMERs); business incubators (KOSGEB-DTIs); and university-industry joint research centers (USAMPs) all aim to sustain continuity of collaboration among private and public institutions to foster knowledge transfers for new product development within a structured framework. Additionally, there are university research service centers such as ODTU-BILTIR, ITU-OTAM, EGE-EBILTEM, etc., that develop R&D research projects with private firms in various or selected sectors. Universities also support existence and development of innovation relay centers (IRCs) and technology transfer offices (TTOs) through their infrastructures, though they (especially the old, strong and structured public universities) are not yet willing to promote commercialization of supported R&D projects.

The establishment of technoparks and their functioning in Turkey is organized by MoIT, under the general principles of enacted TDZ Law in 2001 which aims to promote presence of technoparks and research centers associated with universities. The technopark model is prominent internationally from Research Triangle and Stanford Research parks in the U.S., Tsukuba Academic Town in Japan, Daejeon Science park in South Korea and so on. The basic idea is that positive externalities resulting from clustering research oriented firms, universities and research center in close proximity will reduce the cost of knowledge and technology acquisition for resident firms and entrepreneurs. It is also argues that such local clusters will create attractive labor pools and supportive environments for start-up firms. Following international examples, an additional objective of the technopark and research center initiatives was to bridge the gap between the industry and academia by attracting R&D firms close to universities and providing incentives to academicians to start communication with these firms and/or to start their own businesses near their university base of operations. In this respect, considerable tax incentives (both R&D and non-R&D) are granted to the firms working in technoparks. Academicians who participated in technopark and research center activities were exempted from making payments from their outside work to university revolving funds, which is a normally a major impediment to contract based university-industry research.

Especially before the passage of the new R&D Law (noted above), tax incentives in technoparks were incredibly appealing for firms, as income, corporate profits the incomes of the R&D personnel working in technoparks were exempted from all taxes until 2013. The new Law is expected to reduce the demand for offices in technoparks as significant tax incentives are also provided for R&D firms outside technoparks. Until the recent amendments to the law, demand for technoparks was so high that hundreds of firms were on the waiting lists of all the major technopark developments. The very lucrative tax incentives may have stimulated demand from firms that were more interested in the tax windfalls than in technology development and collaboration per se. The high demand for space also led to significant increases in technopark office rents that in some cases went far beyond the value of the infrastructural services and location advantages provided.

> "The METU-Teknokent was the first-established technopark in Turkey and we were one of the first firms to locate in Teknokent. When we first moved, the infrastructure wasn't prepared and it wasn't complete. No communication infrastructure, no air-conditioning etc. was available. We worked on all those things because we were sure that it would pay off. We wanted to be close to academics in METU-Electronics Department, as we work for the defense industry and the Department has a culture of working with defense firms. We wanted to be within their close proximity. However, this is quite uncommon for most of the firms located in this park. Most have limited collaborations both with the academics and the other firms in Teknokent. We also do not have much collaboration with other firms but we are working on it. There is another firm right across the hall, and they are just perfect for one of the projects we're about to launch. So, the culture, the system is evolving but 2013 is not that far away and before the tax incentives change firms should have some other reasons justifying their presence in technoparks. Otherwise, it is not worth it to pay these high rents for those limited services and collaborations." (Interview with the manager of a TUBITAK Technology Awards recipient firm).

There are now 39 approved technoparks in Turkey but only 18 are known to be active, serving to 890 firms in 2008. The number of personnel, projects and patents in technoparks did increase significantly with the increased government tax, R&D support and technical assistance of various forms. Most firms in technoparks are software or other tech service companies, as manufacturing firms usually do not support the idea of having R&D personnel distinct from their production establishments.

KOSGEB TEKMERs (local business incubators) also aim to support and develop research and development activities of SMEs, usually co-locating them with research centers or programs in universities. There are 20 active TEKMERs in Turkey, which have supported 1,546 projects with $35 million between 2003 and 2006. The support for incubator rent and services is for two years but financing continues for another year when needed.

> "In order to start an application to TEKMERs, firms should register themselves in the KOSGEB database and prepare a "strategic roadmap". After this initial application, they prepare their project proposals and submit it to the TEKMER. Project evaluations are conducted in two steps by two committees. The first committee is the assessment committee and the second committee is the execution committee; this is the technical one. In the first assessment we look for ideas, and assess whether it can be commercialized. We also assess whether the project demands appropriate resources, etc. If we believe that the project has the potential, then we send it to academicians in our university for technical evaluation. If the project receives positive evaluation, we support it with various measures: we provide space in TEKMER buildings for up to 3 years, finance 80 % of the expenses of materials and equipment up to 200,000 TYL, [around 170,000 $], support consultancy, conferences and fair expenses, provide start-up and business development capital. Moreover, if they successfully "graduate", we communicate with technopark management and try to secure a place for them, and help finance their technopark rents. So, the supports are extensive but they are not usually strong enough to attract academicians to start a business as their interest is pretty limited." (Interview with METU-TEKMER)

Bureaucratic duplication, the fragmented structure of the support schemes, lack of coordination among the players, and lack of sectoral differentiation between different TEKMERs were mentioned by several informants as significant problems.

> "The supports we provide in TEKMERs are similar to other institutions' support schemes, such as TTGV and TUBITAK. In order to track the duplicity in applications, to better assess the needs of the firms, we thought about creating an

online database between KOSGEB, TTGV and TUBITAK. Unfortunately, we couldn't achieve it; we couldn't establish a consensus among the institutions and this sustained fragmented structure hinders innovation system in Turkey" (Interview with Hacettepe-TEKMER).

"First, we wanted to influence the composition of TEKMERs, together with technoparks, according to the strengths of universities. METU would support software firms, Hacettepe would support bio-medical, bio-technology and pharmaceutical firms, and EGE would support textile firms, etc. to accelerate the cooperation between the university and industry. However, since the system is determined by the proposals that are submitted, we're tied to whatever comes from below" (Interview with Ankara TEKMER).

Several informants summed up the strengths and weaknesses of existing TEKMERs. Firms definitely benefitted from R&D support and tax benefits, but also the infrastructure and expertise of the universities. However collaborations and consultancy relationships among firms' remains fairly limited in incubator and technopark developments.

Another mechanism for establishing and supporting research collaborations between universities and private firms is university research service centers. Especially the major universities are establishing and restructuring those centers to improve connections and relationships public institutions and private firms. These university research centers aim to solve problems of the industry through their research infrastructures; quality faculty and researchers and basic and applied research project work. The key challenge here is to transform the prevailing consultancy-intense approach and introduce more durable joint and collaborative research efforts promoting the research and product development capabilities of the firms. Depending on which university they belong to, research service centers adopt different structures. While some prioritize multidimensional, interdisciplinary approaches by bringing together academics from different expertise such as METU-BILTIR to address the needs of firms, others prioritize sector based research to enhance the capabilities of a certain industry as in the case of ITU-OTAM and automotive industry. Others emphasize the organizational restructuring needed to address the identified technology access problems of private firms in certain regions. This is done by bringing together all the institutions influencing different phases of innovations as in the case of EGE-EBILTEM. However, all these university R&D centers try to influence the "autonomy vs. relevancy of basic research in universities" discussion in favor of relevancy. Collaborations with private sector are still condemned by many academics because of decades of policies and rules favoring basic research not influenced by forces outside the disciplines or the university. Currently, the research centers structurally challenge this long established culture by persuading academicians to participate in the two-way knowledge flow between the university and private firms. Unfortunately, for many academics, there is still not much of an incentive to develop collaborations as their academic success is still primarily evaluated by the number of research papers published[53].

5.5 The strengths and Weaknesses of the Developing NIS in Turkey from the Prospective of Policy Makers and Program Managers

The evaluation of NIS construction processes in a developing country context necessitates understanding the process at numerous scales and in many dimensions. The broad policy objectives in terms of priority goals and technology development areas are set by a select set of central government institutions. This is no doubt a result of a long history of central government attempts to direct the pace and character of national

[53] The section about university research centers are written based on the interviews conducted with METU-BILTIR, ITU-OTAM and EGE-EBILTEM representatives.

economic development. The specific institutional roles and programmatic responsibilities are evolving and changing as different agencies and departments claim turf and resources, but also as public institutions learn and burnish their capacities to stimulate technological change and innovation in specific areas and segments. On balance, the perceptions and insights of the informants interviewed for this study about the successes, failures and ongoing challenges in their individual program areas was encouraging. Most informants were not simple boosters of their policies or programs or overly defensive about the dearth of meaningful outcome measures in their areas. Most offered critical and analytically sophisticated assessments of their programs and their relationship to the development of the NIS system in general. The responses of these interviewees suggest that a learning culture is operative on some level and that the NIS construction process is changing and evolving as shortfalls, failures and unmet needs are identified.

Indeed the rapid development of public institutions and the serious implementation of support mechanisms in all areas of the NIS system is an important and somewhat surprising finding. This study focuses on about the period (1995-2008) beginning when the Turkish state first developed a coherent strategic vision to accelerate growth in technology development and innovation in response to strong international trade pressures. It took another 7-8 years before this vision was concretized into a coherent NIS based strategy that was backed up by substantial government resources for implementation. The density and diversity of programs and institutions, filling virtually every area or element in common NIS model diagrams, have developed in a rapid and relatively systematic manner. Structures have been developed in the legal area, in numerous areas of R&D support and tax subsidy, in an array of technical support and assistance areas, in firm-university collaborations and partnerships, and in spatially based technoparks and business incubators. Services are directed to numerous industrial sectors, to large and small firms, and to entrepreneurs and business startups. Of course this has not been a seamless or even process; major gaps and serious performance problems were identified throughout the system. Yet the fact that most of these institutions, programs and projects were developed and implemented over the past decade is surprising. And even with all the problems identified, there appears to be a degree of coherence in the overall structure and business participation has been in most cases has been strong.

In addition, the institution building and public investment associated with the NIS construction project over the 14 years was at least associated with positive movements in key national science and technology indicators over the period. Growth in various categories of R&D, especially private sector R&D investment was relatively robust. This corresponded to an increase in R&D personnel and the production of scientific articles. Most significant was the relatively strong increase in patenting activity that was associated with positive movements in the other indicators. While there is almost no evaluative data tying various policy changes and program interventions to these aggregate science and technology and innovation indicators, it can be said that the change in government commitment and the change in the environment related to NIS construction did contribute to a move toward more technology based growth over the past decade.

The analysis and interviews did put into relief common concerns and perceived limitations of the current NIS strategy. Criticisms were directed to both strategic goals and elements and more tactical matters of program design and implementation hurdles. At the strategic level the most prominent concern was the detachment of the NIS construction process for any coherent industrial strategy tackling industrial objectives such as increasing the competitiveness of current or potential export industries through a broader science and technology framework was seen as a major flaw in the national strategy. The core assumption is that if the state invests in science and technology assets at the national level, the general competitiveness of the country will increase. The failure to strategically link new and emerging technologies to specific industrial development goals may be more risky in terms of inefficient resource use than some of the well rehearsed pitfalls of industrial policy (e.g. betting on the wrong industry). The issue is not moving to apply older forms of 1960s or 1970s industrial policy, with strong state direction, but in matching science and technology development with the science and technology bases of specific growth industries. For example, it seems sensible to encourage biomedical firms to locate in technoparks and link with research centers near clusters of universities, research and medical centers with specific research strengths valuable to the biomedical industry. NIS related R&D and technical support could be usefully structured and targeted in this instance to build up these natural relationships. As several commentators noted a more sophisticated industrial targeting and linkage strategy could also limit overlap and redundancy among programs. The risk of the bottom up approach with little industrial targeting is shown above in the extreme case of the large VC investment in a bread company, an industrial sector with slow growth and excess capacity.

In a related sense, the scope of policies and programs reflect the dominance of supply side measures and lack of demand side policy levers such as procurement and regulation and standards policies. Public procurement of innovative goods and support for private procurement policies do not exist outside of the defense sector mostly due to lack of an industrial policy. The lack of a sectoral emphasis on demand side measures is compensated for in the Turkish NIS through technology platforms to coordinate development among actors interested in or working on similar technologies. However, like many others, this initiative is too new and not continuous.

The most common and troubling criticism of participants in the area of NIS program implementation is the absence of any serious or systematic monitoring and evaluation of programs and projects. Much of the literature on national science and technology and industrial policies emphasizes the crucial need for monitoring, evaluation and program learning and revision. Evaluation should be built into program design so that program goals are clear and match larger strategic goals of the national investment program. Almost all of the informants that were interviewed highlighted this concern in various ways. The link between the objectives of increasing national competitiveness and how well the new system is addressing this objective is not evaluated in a timely and systematic manner. Most informants emphasized the need for serious assessments and critical reports at the policy and plan making level with respect to how the current system is serving the stated objectives, how and in what ways the adopted NIS system promotes the development of comparative advantages, and what factors place Turkish industry on a competitive footing in international markets.

As the discussions evolve on the future models of global innovation and innovation networks, successful future NIS construction demands adaptive policy makers with monitoring and evaluation systems that create critical information and feedback for policy making, learning, and policy revision. The NIS construction process in Turkey has been strongly influenced by other international models and has been developed under the strong influence of international organizations including the GATT, Customs Union with EU, World Bank Development Programme and various EU integration initiatives. While this international influence strengthened the systemic nature of NIS construction through careful analysis of other country examples, the absence of evaluative information provides policy and program managers with little insight on how the Turkish context affects the success of failure of these imported models. In fact, the one element emphasized in the international literature and program reviews is the need for serious program evaluation as NIS elements are put in place and integrated.

Any constructive NIS evaluation demands a holistic approach on whether existing measures advance the broader national development goals. However, the crucial mechanism influencing national development is increased technological change and innovation in private firms. Thus, the main goal of the following chapters is profiling and analyzing this key locus: the private firms, their technology and innovation strategies, interactions with external public and private institutions, and their local/regional environment. In this chapter we looked at the system from the purview of program designers and program managers. In what follows the character and perspective of the key subjects of the NIS elements will be examined. These chapters intend to articulate the major barriers and opportunities for technology adoption and innovation in firms - and how well they are addressed with the current policies and programs in the system.

Chapter 6: Evaluating the Innovation Processes of Turkish Firms

This chapter explores the processes of technological change and innovation in Turkish manufacturing firms in the Ankara, Izmir and Istanbul regions. To understand in concrete terms how NIS institutions and resources are influencing the technology adaption and innovation activities of private firms, survey and in-depth interview results are presented and analyzed for all 83 firm respondents. Specifically the findings of the surveys and interviews will be used to profile the organizational practices and performance of these private firms in regards to technological adoption and innovation, the extent and importance of external linkages, and the importance of local versus non-local relationships on the firm's capacities for technological change and innovation. Regional characteristics and differences between firms across the three study areas are examined in more detail in chapter 7.

As shown in the previous chapter, policy makers, planners and technology experts emphasized that the NIS construction project was launched in an environment where the culture for innovation within firms was weak and the institutional interrelationships supporting technological advance and innovation were spotty and fragmented. As emphasized in the literature review, almost all theories of national and regional innovation emphasize the central importance of two core factors: 1) a diversity and density of institutions directly or indirectly supporting processes of technological adoption and innovation in private firms (R&D support institutions such as universities, technical support institutions such as technical assistance organizations and incubators, supplier and producer networks, supportive financial institutions such as VC and angel investors, and business and industry associations); and 2) specific and durable relationships between firms and public and private institutional actors that serve to advance the capacities of firms for technological improvement and innovation.

The aim of this chapter is to profile and analyze the innovation processes of Turkish firms highlighting their innovative activities and outcomes and the nature and importance of collaborations with external entities. This evidence from a large set of firms that have received government innovation grants and loans can provide valuable information on both the presence and importance of specific external linkages for the innovative activities of the firms. It can also provide useful information on the importance and strengths and weaknesses of evolving NIS structures and institutions from the perspective of the participating firms.

In this chapter, I begin by outlining key characteristics of the sample firms in terms of employment size, industry affiliation, age, and ownership structure. In the second section the actual innovation strategies and performance characteristics of the sample firms are analyzed including the pressures and motivations to implement R&D and product and process development projects. In the third section, the sources and information and know-how that sample firms draw upon to carry out technical upgrading and innovation are explored. In particular, the relative importance of internal firm resources versus external sources is analyzed through the survey information. In the fourth section, the perceptions of the firms regarding competencies most important for successful technological adoption and innovation are examined including competencies within the firms and competencies and capabilities to acquire resources and knowledge outside the firm and through external collaborations. In the fifth section barriers to innovation and effective collaboration are studied. In the sixth section we look at survey results detailing the geographic characteristics of linkages and external relationships, specifically the extent to which linkages and relationships are within the host region of the firms or at the national or international scale. In the concluding section these results will be summarized in reference to the literature on the importance of institutional "density and diversity' and external linkages on innovation performance.

6.1 Profile of the Surveyed Firms

In the survey aspect of the research, 83 firms were surveyed in total in all regions. As far as the distribution of the sample is concerned, the highest concentration of firms lies in 4 sectors: manufacturing of machinery and equipment (30.1 %); computer, electronic and optical products (14.5 %); motor vehicles, trailers and semi-trailers (12 %) and chemicals and chemical products (14.5 %). The rest of the firms are distributed unequally among 12 sectors: manufacturing of electrical equipment (8.4 %); fabricated metal products; and rubber and plastic products; (both 4.8 %); non-metallic mineral products; pharmaceutical products and preparations; other transport equipment; and other manufacturing; (all 2.4 %) and manufacturing of food; and basic metal (1.2 %). According to their technological bases, 27.7 % of the firms can be classified high-tech firms; 54.2 % of them medium-tech firms; 13.3 % of the firms are low-tech firms and 4.8 % of them are resource based-firms[54]. All the firms, as the recipients of TEYDEB and/or

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[54] There are many approaches to categorize products by technology. Here I adopted the categorization used by Lall (2000), where he develops a categorization combining the approaches that make a distinction between "high tech" and "low-tech" according to R&D intensities; and also the OECD (1987) classification where the products are differentiated as resource based; labor-intensive; scale intensive; differentiated and science based manufactures. Lall's categorization differentiates manufactures as resource based; low technology; medium technology and high technology. Resource based: mainly processed foods and tobacco, simple wood products, refined petroleum products, dyes, leather (not leather products), precious stones and organic chemicals. Low-technology: such as textiles, garments, footwear, other leather products, toys, simple metal and plastic products, furniture and glassware. Medium technology: mainly automotive products, most industrial chemicals, standard industrial machinery, and simple electrical and electronic products. High technology: fine chemicals and pharmaceuticals, complex electrical and electronic machinery, aircraft and precision instruments.

TTGV R&D supports can claim to be engaged in some form of innovative activity, though the range and type of innovation or technology adoption varies significantly. Many of the firms are specialized. For example the product lines included industrial robots for the automotive industry; electronic control systems; orthopedic surgical implants; air ionizers and filters; special purpose machinery for process control and assembly lines; flat and plasma TVs; glass fibers; branded generics of antibiotics; custom designed heat treatment plants; electronic warfare and intelligence; independent unmanned air-vehicles; aircraft manufacturing; micro-biological safety cabinets; anesthesia and intensive care unit systems; industrial powder coatings, etc.

A majority of the sample firms are larger, independent family firms, established as independent start-ups by current owners - 42.2 % of the sample have more than 250 employees; and 32.5 % of the firms are family firms; reflecting a significant characteristic of Turkish industry. The organizational form of the surveyed firms show that sample firms are dominated by independent firms (63.8 %), 32.5 % of which are independent family firms. Firms that are joint ventures or that have equal partnerships with foreign firms comprise 9.6 % of the whole sample.

Over eighty percent of the firms began their operations as new independent start-ups and in terms of age, 61.4 % of the sample firms are founded after 1981: 32 firms (38.6 %) started their operations before 1981. Of the firms founded more recently, 21 firms (25.3 %) were founded between 1981 and 1990; and 30 firms (36.1 %) between 1991 and 2006. Firms' main types of business activities at the establishment level (within the establishment surveyed) included manufacturing (92.8 %), management (90.4 %), sales (91.6 %), and marketing (67.5 %) suggesting a degree of vertical integration. More firms produced final products (81.8 %) than intermediate products (35.1 %). Over 43 % of the firms reported a sales volume more than $50 million. It is noteworthy that 92.8 %

Table 6.1 General Characteristics of the Sample Manufacturing Firms

General Characteristics	Number N=83	Percentage %
Industry Classification		
Machinery and Equipment	25	30.1
Computer, Electronic and Optical Products	12	14.5
Motor Vehicles and Trailers	10	12.0
Chemicals and Chemical Products	12	14.5
Electrical Equipment	7	8.4
Fabricated Metal Products	4	4.8
Rubber and Plastic Products	3	3.6
Pharmaceutical Products; Non-Metallic Mineral Products, Other Transport Equipment; Other manufacturing	8	9.6
Food Products; Basic Metals	2	2.4
Employment Size		
Less than 50	20	24.1
50-250	28	33.7
Over 250	35	42.2
Firm Type		
Large Firm (Over $25 million in sales)	43	51.8
SME (Employment < 250 & Sales < 25 Million)	40	48.2
Foundation Date		
<1950-1980	32	38.6
1981-1990	21	25.3
1991-2006	30	36.1
Corporate Status		
Independent Firm	26	31.3
Independent Family Firm	27	32.5
Headquarter of a Firm	15	18.1
Joint Venture and Equal Partnership	8	9.6
Types of Activities		
Manufacturing Final Products	63	81.8
Manufacturing Intermediate Product	27	35.1
Marketing	56	67.5

of the surveyed firms sell in international markets, mainly Europe, Middle-East, Russia, Central Asia and Northern Africa.

6.2 Innovative Practices of the Surveyed Firms

Innovation is a complex process which encompasses much more than just technology. And over the years, many typologies have been proposed to provide better insights of this complex process. Schumpeter (1934) as an early and founding contributor identified five forms of innovation carried out by business firms-new product; new sources of supply; new methods of production; new market exploitation; and new business organization) Schumpeter's types, or categories of innovation strongly influenced the typologies and definitions found in the Oslo Manual (OECD)[55], containing the most prominent international guidelines explaining the collection and use of innovation data in various industries. Technology management literature also shows that while some firms emphasize distinct innovations types (such as product innovation), others embrace a blend of innovation activities (for instance product, process and organizational innovations) that determine the success of their innovation processes (Patel and Pavitt 1987; Granstrand 1998). As such, firms, especially technology oriented firms, characterize their overall innovation processes differently. In a general sense, however, the innovation process of firms starts with identification of a market and/or

[55] According to Oslo Manual (2005) there are 4 types of innovations: product, process, organizational and marketing. Product innovations are goods and services that are "new or significantly improved with respect to its characteristics or intended uses. This includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics". Process innovations are "implementation of a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software." Organizational innovations are "implementation of a new organizational method in the firms' business practices, workplace organization or external relations". Marketing innovations are "implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing".

associated technology opportunity; develops or adapts an existing technology that fulfills the observed opportunity; and, if successful, moves the new technology or product to the market by commercializing it directly, or transferring the technology to other institutions (Jain and Triandis 1990).

In this study, all the sample firms were selected on the basis of some form of "product" innovation since the sample was drawn from companies that had won competitive government grants for specific innovation projects. This "predefined" sample was useful in understanding the factors supporting technological activities (mostly R&D) and technology-based products in the Turkish NIS construction process. In this respect, firms were asked a number of questions about their new product development processes. The firms were asked if they have introduced any technologically new or improved product into the market during the last three years. As expected, all firms in the sample as the recipients of TEYDEB-TTGV supports, affirmed introduction of a new product into the market within the stated span of time. Half of the firms reported having introduced 1 to 5 new or technologically improved products into the market, while 31.2 % of the firms introduced more than 10 new products providing at least some evidence that these firms had adopted a relatively aggressive innovation strategy even though innovations were incremental. A large majority of the firms (89.2 %) emphasized that new product introductions were a first of their kind in Turkey, which was congruent with the export expansion–import contraction objectives of the government innovation support programs. Only a small fraction, 13.3 % of the firms, reported the novelty of their products as a first of their kind in the world market. This is consistent with the expectations that limited capital and human resources, industrial experience and research capabilities, and cutting edge technical and market knowledge, made globally leading innovations rare in the context of Turkey's overall level of technical development.

Table 6.2 Types of R&D Activities

R&D Activities	Number of Firms	Percentage
Basic Research	1	2.4
Applied Research	56	67.5
Processes Development	66	79.5
Product Design	78	94.0
Prototyping	64	77.1
Product Testing	74	89.2

In order to understand the composition of firms' product innovation efforts, firms were asked questions about the type and extend of their research and development activities[56]. The firms' emphasis on basic research, applied research and experimental development varied significantly. There was in some circumstances a lack of clarity in the respondent's minds about the meaning and definitions of these categories. Definitions were given in the interview process but some ambiguity may have remained. Aside from one big defense firm, none of the firms mentioned conducting basic research. A large majority of the firms asked for a clearer definition of basic research as they wanted to make sure that it was different from their applied and experimental product development research.

> "Basic research is the kind of research that aims to provide new scientific knowledge and understanding. This is the kind of research that is done in universities and is mostly funded by governments. I can say that in [name of the

[56] According to OECD Frascati Manual (2002:30), "Basic research is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts, without any particular application or use in view". "Applied research is also original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific practical aim or objective". "Experimental development is systematic work, drawing on existing knowledge gained from research and/or practical experience, which is directed to producing new materials, products or devices, to installing new processes, systems and services, or to improving substantially those already produced or installed. R&D covers both formal R&D in R&D units and informal or occasional R&D in other units".

company] we indirectly conduct basic research as we hire and support engineering PHDs without any strings on their research topics. Defense is a very specialized field with diverse areas of interest including communications, tracking, surveillance, navigation, etc. and the most important thing is to have the best people. Once you have them, once you bring their knowledge in the company, one way or another, it shapes the scope of your future R&D projects."

"The distinction between basic and applied research is blurry for us. We employ graduate students of Professor [name of the professor] in [name of the university] who has been providing consultancy services to our firm for years. Our objective in this arrangement is to make sure that solutions to some of our problems are researched extensively by quality researchers in longer periods of times. But, do we conduct basic research in this way?, I'm not sure… Because what is basic research in one year; becomes an applied research in another year in this arrangement."

Over 67 % of the firms interviewed declared applied research as an important type of research activity for themselves. This is somewhat less than the share of firms that reported conducting experimental development as in the form of process development (79.5 %), product design (94.0 %), prototyping (77.1 %) and product testing (89.2 %). In general, applied research translates into the more speculative and risky phase of an innovation process in which firms invest in inventive work to come up with technological advances that are viable and potentially marketable. As all the firms in the sample performed some form of product innovation, in explaining their innovation processes, they emphasized either their applied research or product design processes. Process development in this context was usually mentioned as part of their general capital investment process that was mostly needed for the development and testing of new product prototypes or needed to move to the production phase for a new product.

"Process development? Of course. If you define yourself as innovative, process development is an inevitable consequence.. a natural component of your product development effort. You need new software in the design phase, or new CNC lines in the production phase.. Buying them does not make you innovative, using

> them, creating new values in your product makes you innovative and competitive."

The majority of the firms in the sample believed that their ability to innovate was primarily related to their technical expertise and competency rather than organizational and managerial proficiency in selecting and managing projects and bringing a new product to the market. Most firms in the sample, in other words, associated technological change with technical capacity and overcoming technical problems. It is noteworthy in this context that 54.2% of the firms noted that they engaged in reverse engineering in their product development efforts. "Steal and develop" was a frequently stated phrase especially among small machinery firms to indicate more "development" than "research" in R&D activities. However, all of the firms emphasized that they were not simply copying, but were taking advanced products developed elsewhere, adapting the core technology concept, but making significant changes to meet the specific needs of their customer base. Firms were less interested in other areas of innovation such as introducing new marketing techniques (50.6 %) or changing existing management routines (24.1 %), reflecting more of a project-based versus a more systemic and structured technology management approach.

> "We're much less interested in introducing new marketing techniques because we don't start a project if it's not intended for a customer. In this respect, management's attitude towards risk is very conservative. We undertake risky projects on the technical but not the sales side… As I said, this is a family firm. The owners are two brothers who are in their early 50s and graduates of METU Electrical Engineering Department. They have an incredibly connected network as METU EE alumni are everywhere and hold key positions in a lot of key institutions. In this sense, our managers through their networks make intuitive decisions/inferences about possible market opportunities. Who are technology-driven customers, how easily they adopt and invest on new technologies, etc. But no, we don't employ marketing people or work with marketing firms that make market analysis to guide our investment decisions."

> "Changing management routines are hard. It's usually harder in family companies as who makes the company are your father, brother or sister. Family members usually hold managerial positions in small firms and it's really hard for them to step-down unless there is a personal reason. This has positive and negative aspects. On the positive side; depending on management's orientations and willingness toward R&D, persuading them to launch innovative projects is easier especially if you're supported by another family member. On the negative side, if two-out of three managers say they are against it then you have to work really hard to convince them, say you have to look for government support, etc. In this sense, changing existing management routines are hard to achieve as the professional relations are more personal and intertwined".

With respect to their R&D expenditure which obviously is an important measure of R&D activity, 64.5 % of the firms spent less than 5 % of their sales revenue on R&D, while a large proportion of the firms (35.5 %) spent between 2-5 % on R&D activities. Only 16.1 % invested more than 10 % of their sales on R&D, while 9.7 % invested less than 1 % of their sales. The mean value of R&D expenditure over total employment among the survey firms is $24,871. This ratio was$14,127 dollars for SMEs and $39,335 dollars for big firms, reflecting the higher intensity of R&D activity among the large firms.

Another important measure of a basic commitment to technology adoption and innovation is the employees directly dedicated to R&D activities. A majority of the firms (80.5%) perform their innovative activities using less than 20 dedicated employees, while 35.4 % of the firms support between 6 and 10 dedicated R&D personnel. Only 9.8% of the firms have more than 100 R&D employees. Considering that a significant share of firms in the sample are large firms (42.2 %), the share of the labor force dedicated to R&D remains relatively small in comparison to their total workforce.

Patent data provides an imperfect but very concrete measure of the outcomes of R&D and innovation activities. Half of the sample firms, 42 out of 83, applied for patents[57] over the past three years as a result of their R&D and innovation efforts and 26 firms out of the 42 firms that applied (66.7 % of firms applying for patents or about 31% of all sample firms) were awarded patents in the same time period. Of the 26 firms granted a patent, sixteen (61.5 %) were awarded patents issued by the Turkish Patent Office, while 7 out of 26 firms (26.9 %) were issued patents by the European Patent Office (EPO). Big firms were significantly more active in the patenting process. While large firms with more than 250 employees represented only 42 percent of the total sample, about 54 % of all firms that were awarded patents were big firms.

It is difficult to draw definitive conclusions from this patenting data without clear benchmarks from other Turkish or international firms. However, the broad claim that firms participating in R&D support programs were just using funds as a general firm subsidy or that most funds were going to support ongoing incremental product improvements is refuted by these data on patenting. About half of all firms had developed new or improved products that were viewed as patent worthy innovations and close to a third of all firms had received patents on their products.

On the other hand, a significant subset of firms did not view patenting as an important outcome of their supported projects[58]. Major reasons for lack of interest for patenting were: a lack of patentable outputs; expensive and onerous application processes; and firms' 'no-patent policies' due to skepticism that patent protection would effectively protect their property rights in domestic markets. Typical statements include:

> "Patent applications are not one of our priorities. We produce customized machineries which are new for our firm and also for our customers in many ways. Our customers come to us with an idea, in most cases with a blurry one, and after

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[57] Some of the firms also included in their success model applications, as they were not sure about the exact distribution.

[58] During the interviews, only a small portion of firms seemed enthusiastic to explain their patent process and its value and significance for the firm's competitive position. Many respondents were unable to convey exact figures, reflecting the limited importance given to patent applications within their firms.

rounds of discussions we stretch our limits and shape their needs. In some instances, we promise products with features that we have no prior experience producing. You can't imagine the amount of uncertainty in the beginning. It's so chaotic, so ambiguous and so experimental. But we love the process, looking for the unknown… Such an enjoyment and of course stress… When we're finally done with the product, in a majority of the cases, it is not patentable. There are many firms out there, foreign firms, old firms with great industrial experience that make machines with similar features… It is new to us but not to them.."

"The patent application process is expensive and also there is so much red-tape. That is very discouraging.. On the other hand, with the increasing government support for patent applications, many patent firms are established.. These firms employ lawyers and technical staff and they evaluate the congruity of your application to TPE (Turkish Patent Institute) requirements. At this point, we're (management) not sure we want to go through this process; we don't want to convey information about ourselves to third parties".

"Patents are very sensitive to sectors and the composition of the sectors in the country. Patents laws, their proper application, etc. are secondary. You see this palm-sized package; it is used for insulation purposes in the construction industry. It is a market shattering product. [Explains the advantages of the product in comparison to conventional insulation technologies] Can we get patents for it? Of course.. But we don't want to. Because once we get the patent; it will be available to our competitors. With minor changes in the product, they will enter into the market. At this point, we don't want to disclose our know-how to everyone. It is in our best interest to keep it to ourselves".

6.3 Reasons for Innovating

In order to understand the reasons prompting firms to make commitments to innovation activities companies were asked to indicate the importance of their reasons for conducting innovative activities on a Likert scale from 1: Very Important to 4: Not Important. Firms were asked a number of questions about why they carried out innovation projects. The most commonly stated reasons for undertaking innovation projects were related to improving sales by bringing better or new products to the market.

These basic motivations included complying with the demands of customers (m=1.19); increasing product quality (m=1.27); extending product range (m=1.31); and dealing with competitors at home (m=1.84).

A great majority (80.7 %) of the firms noted that complying with the demands of customers was very important, while 19.3 % of the firms' indicated that it was moderately important. Uncertainty in the success of developing new products was alleviated to a degree if they understood the concrete needs of their customers and had some confidence in their ability to improve products or innovate in ways that met specific customer demands. The ability to target innovation activities to meet concrete needs articulated by existing customers has been highlighted as a critical stimulus in some of the innovation literature, most notable Von Hippel's studies of the importance of users in the innovation process (Von Hippel, 1988). Firms, once they understand the specific needs of customers, are much more inclined to launch new projects. In this way, they are less prone to risk and uncertainty if they understand specific demands instead of generating a new product for a sometimes poorly defined or uncertain market. The qualitative information and open ended responses from the interviews gave the clear impression that innovation in the Turkish context was much more commonly a "demand pull" versus a "supply push" process.

> "A previous customer of ours in Iran asked for new metal processing machinery. [He explains how the new machinery was different from their current products]. That was a machine requiring new technology that we didn't know but I could see ourselves accomplishing the project with the involvement of our strategic partner in the USA. That was a risky move. Anyways, I gave them a call and they agreed to be involved in the project. I made the deal with our customer, but after a short while I received a call from our partner stating that legally it is impossible for them to get involved in any kind of technology transfer activity with a firm in Iran. I immediately went to the USA to sort things out with our partner. They said there's nothing that they can do. And, I said at least tell me how I should do it. They refused and said they don't want to go to jail. I was so frustrated. When

everybody was away, an old design engineer showed me on the back of an envelope how I should think about it. Our engineers and I worked on the project for nights, got some help from a consultant and finished the product. That felt so good but I highly doubt if I ever would like to be in such a position again."

Table 6.3 Firms' Reasons for Innovating

Reasons For Innovating	Likert Mean
Comply with the demands of customers	1.19
Increase product quality	1.27
Extend product range	1.31
Achieve market leadership	1.65
Deal with new competitors at home	1.84
Decrease production costs	2.17
Availability of government support	2.22
Deal with new competitors in export markets	2.23
Decrease processes costs	2.42
Comply with local laws or standards	2.67
Develop more environmental friendly products or processes	2.75

Likert Scale- 1: Very Important 2: Moderately important 3: Slightly Important 4: Not Important

Increasing product quality and extending product range were the next two most important reasons for innovating as mentioned by 75.9 % of all firms. Typical statements included:

"Primarily, we innovate to differentiate from our competitors. A product's life in our sector is pretty short so we have to remain competitive by increasing the quality of our [name and type of products] to exist and establish in the market. Mostly, our customers are loyal as they know we keep improving the quality of our products."

"Most of these reasons are important components of any innovation process… The structure of our firm, its financial and administrative capacity is too limited to set the goal as achieving market leadership. That would be very unrealistic. But we do product development and we do it well. We mostly take an existing idea, an existing product and try to expand it in better and cheaper ways. We try to understand the specific customer needs, in our case mostly the municipalities and try to offer something better, something unavailable or unmet in the market."

The least important reasons for innovation activities indicated in the surveys and interviews were developing more environmental friendly products or processes (m=2.75) and complying with local laws or standards (m=2.67). It is also important to emphasize that government demand side measures such as regulations, standards and norms did not appear to be important factors influencing the innovation practices of the firms. Roughly 60 % of the firms declared that complying with local laws or standards was only slightly important or not important for their innovative activities. However as EU integration efforts continue and Turkish firms attempt to more aggressively penetrate European markets attention to quality control and standards is becoming much more intense. In certain ways, these demand side pressures related to the European integration project have substituted for domestic demand side/ industrial policy measures to drive technology adoption and upgrading.

> "The turning point in our product development efforts was to continue to exist in the European markets. When the existence of brake pads with asbestos was banned in Europe, we had to make a choice: to stay in or exit from the European markets. Our managers are visionary people and they are fast movers. They saw this as an opportunity and eliminated the use of asbestos in the production. We searched for other materials, ceramic etc. to replace asbestos. The transition process necessitated acquisition of a lot new knowledge, technique, materials, and artifacts together with organizational restructuring. But it paid for itself. A lot of firms are now struggling to adjust themselves to new market conditions."

Availability of government support also appears to be a significant, but not primary factor in motivating firms to carry out innovation projects (m= 2.22). Firms which considered government support very important make up 19.3 % of the whole sample, while 42.2 % of the firms thought availability of government support a moderately important factor motivating innovation projects. While a clear majority

(61.5%) saw government support as very or somewhat important, 36.1 % of firms thought support slightly important while only 2.4 % of the firms said the availability of government support was not important.

Firms' responses were mixed depending on how they value the existing government support and their ability to access it for the success of their innovative product and process efforts. The organizational structure of the firms; their positioning of innovative products for market leadership; their age and size ; financial strength and the capacity to reach out to other financial resources all appeared as relevant factors (combined with the efficiency and effectiveness of the innovation programs) influencing their evaluation of the importance of government support programs.

The interview process provided additional information on why firms saw government support as valuable to their innovation efforts. Many small, conventional and financially challenged manufacturing firms highlighted the crucial contribution of support programs to their product development efforts. Many could not have mobilized the resources to carry out dedicated product development projects without government encouragement and subsidies. However, smaller firms also mentioned the difficulty of the application process, the challenges they went through to compile the application package, and problems with the irregularity of the payment process.

> "We use TUBITAK's R&D support program and we're extremely happy about it. It covered a big part of our expenses and we managed to hire a new engineer who later became one of our own. The application process is tedious, that is true, but you're getting free money. Can you imagine how much you would have to work to earn for it? I believe everything comes with a cost and that's it. TUBITAK is just trying to make sure that the allocated money will be used for the intended purposes."

> "The government is promoting the R&D idea lately. TUBITAK has been involved in a wide range of awareness rising activities such as organizing seminars;

presentations on government support programs; technology award competitions etc. The more we hear about those, the better we understand that we're actually R&D firms. What's highlighted is what we have been doing for years. So, why not to apply for government R&D funds? Well, the experience showed us that there is a reason, an important one.. The process is too burdensome. There are so many documents, multiple copies of which you have to provide to make an application. Somebody is always working on the application package. Sometimes I feel like I have to hire another person to keep track of our TUBITAK files".

"Oh well, yes, preparing the package, the application materials, really keep you busy. Lots of firms refuse to get involved in this process both because they don't have any experience or time and they hire a consultant who is actually specialized in preparing packages to TUBITAK. It is something like hiring an accountant. Good wording and presentation increases firms' chance of receiving "free money" which in majority of the cases firms needs most".

Relatively big and/or technologically sophisticated firms which have been the recipients of these awards emphasized the importance of government support programs in putting product development projects in front of firm leaders and convincing the upper management to start a new project. Getting upper management to approve projects was definitely facilitated by the fact that government was subsidizing almost half of the project costs. The financial strength of larger firms made problems with the payment schedule of grants less of an issue because the day-to-day progress of their projects was not contingent upon the money coming from the government. Some new technology firms, on the other hand, which were ambitious about creating and entering new markets, criticized the uniformity of support program design, especially the lack of clear distinctions between projects that aim for simple improvements in product and process technologies; and projects that target to bring in new technologies that create new markets in Turkey.

"We obviously don't start a project just because there is government support for it. But we (R&D engineers and manager) use the availability of funds as an

> opportunity to convince the upper management. We usually find ourselves explaining: see if you invest [that much] the government will cover the rest. It is well worth trying as the project topic is very promising and presents a good opportunity, etc."

> "We all, three partners of this firm, used to be working at [name of the company] in USA. After more than 10 years of experience, we decided to come back to Turkey to start a new business based on our [name of the company] experience. The timing was great as the communication and Internet infrastructure was newly developing in the country. Our objective was to be one of the first movers in the Turkish market by offering products that addresses domestic needs with high quality technologies before the international companies dominate the market. Government support at this phase was so important for us. Unfortunately, the support system was so static that it was no use at all… We actually got ourselves into trouble by believing in the official payment schedules".

The in-depth interviews with innovative firms showed that a certain categorization of technology firms is needed to get a deeper understanding and better analysis of the innovation processes of the firms, their capacities, knowledge sources and their geographic orientations. Technology firms are usually defined based on certain categorizations or metrics in the literature. Specifically, a firm was noted as a high technology firm when it belonged to certain industries such as computer, software, aerospace, computer-aided design etc. or a low technology firm if it belonged to an industry with low average technical standards such as the textile industry (Dunn et.al. 1991). In a developing country context, these classifications are less illuminating. In Turkey there are many firms in the software industry performing minor product improvements or just distributing software produced elsewhere, while highly specialized textile companies are producing high-tech fibers that may be unique in the world market. The most common factors that define technology firms are : above average ratios of R&D activities and expenditures (Pavel and Pavitt 1984; Medcoff 1999); high ratios of skilled employees typically engineers, scientists and technicians as a share of the total workforce (Itzak and Ilan 2004); the complexity of products produced (Mac Donald 1985); the emphasis on the applied research versus product development (Ansoff and Stewart 1967); the new products and their innovative characteristics (Deeds et.al 2000); management's attitude and commitment towards R&D, change and risk (Shanklin and Ryans 1987;Von-Gilnow and Mohrman 1990; Easingwood and Beard 1996); and a flat and integrated organizational structures (Mohrman et al. 1992).

For the purposes of this research, I wanted to categorize firms according to their orientation towards R&D and new product development, their ability to produce complex products, and to differentiate types and strengths of their external networks. Four categories were developed to clarify the firm's motivations for undertaking innovation projects, their level of technological capacity and the commitment to technology upgrading among the firms in the sample. These categories are based upon the suggestions of a technology expert in TTGV, who has an intimate knowledge of Turkish industries and of product developing firms because of his involvement in TTGV's R&D support program. After investigating firms' orientations towards R&D activities and investment through common survey questions, and evaluating their significantly different product development stories through open ended questions and interview queries, firms were classified according to the following categories:

A. Firms that are not generally interested in developing new products, but are under pressure to improve or extend their existing products to meet demands of their customers and remain competitive in their traditional markets;

B. Firms that are developing an interest in new product development but have limited experience and limited commitment to applied research;

C. Firms that are actively searching for and developing new products based on advanced technologies that exist in global markets;

D. Firms that are involved in cutting-edge technology development practices and projects, (which is usually is very rare in the Turkish context).

Table 6.4 Firms' Reasons for Innovating According to Their Orientation towards Product Development

Reasons For Innovating	Mean all groups	Mean group A	Mean group B	Mean group C	Mean group D
Comply with the demands of customers	1.19	1.19	1.24	1.17	1.33
Increase product quality	1.27	1.41	1.29	1.14	1.33
Extend product range	1.31	1.67	1.29	1.08	1.00
Achieve market leadership	1.65	2.22	1.53	1.33	1.00
Deal with new competitors at home	1.84	1.93	1.35	1.97	2.33
Decrease production costs	2.17	2.00	2.18	2.28	2.33
Availability of government support	2.22	2.30	2.47	2.08	1.67
Deal with new competitors in export markets	2.23	2.81	2.35	1.78	1.67
Decrease processes costs	2.42	2.37	2.47	2.44	2.33
Comply with local laws or standards	2.67	3.04	2.82	2.33	2.67
Develop more environmental friendly products or processes	2.75	3.04	2.82	2.50	2.67

Likert Scale- 1: Very Important 2: Moderately important 3: Slightly Important 4: Not Important

According to this classification 27 of the surveyed firms were assigned to the first category; 17 firms to the second category; 36 firms to the third category and 3 firms to the fourth category. This sort of classification made the aggregated data more legible and explanatory in several ways. For instance the importance of extending product range; achieving market leadership; and dealing with competitors in export markets become more important reasons for engaging in innovation as the firms' orientation towards product development-oriented R&D increased. Likewise, availability of government support was more important for firms in group C and D engaged in more real new product development activities or more advanced and cutting-edge technology development. In light of this classification framework, government support assumes more significance as firms engage in more aggressive attempts to expand markets through the development of new products and technologies. It is noteworthy that this finding is consistent with the core goals of the current phase of Turkish innovation policy and investment in the NIS that include the promotion of new product development and entry into new market areas (see Table 6.4, above).

6.4 Competencies Associated with Innovative Practices

The core competencies of a firm are the unique skills and capabilities that give the firm its competitive advantage. They include capabilities such as the quality if its people; information exchange and learning processes within the firm; the capability to acquire know-how from outside sources, etc. that enable the firm to deliver valuable products to its customers. In order to identify the emerging and divergent needs associated with the developing NIS, firms were requested to assess their organizational, technical, financial and collaborative competencies associated with their innovative activities through a number of queries.

Organizational Competencies

Table 6.5 Organizational Competencies

Organizational Competencies (% of firms)	VI	MI	SI	NI	Mean
Identification of the knowledge and strategic know-how	51.8	44.6	3.6	0.0	1.52
Identification of the people holding strategic know-how	60.2	27.7	12.0	0.0	1.52
Pooling of knowledge from across the firm	47.0	51.8	1.2	0.0	1.54
Organizing the company around innovative projects	42.2	37.3	19.3	1.2	1.80
Encouraging joint project teams to innovate	38.6	38.6	16.9	4.8	1.88
Incentives to formulate new ideas	26.5	53.0	18.1	2.4	1.96
Making everybody aware of the need for adapted training	25.3	47.0	18.1	9.6	2.12
Rewarding the ideas that have been selected	8.4	20.5	32.5	38.6	3.01
Evaluation of the impact of training on the innovation process	4.8	21.7	39.8	33.7	3.02
Rewards for useful training	3.6	1.2	8.4	86.7	3.78

VI: Very Important, MI: Moderately important, SI: Slightly Important, NI: Not Important
Likert Scale- 1: Very Important 2: Moderately important 3: Slightly Important 4: Not Important
Mean equals Likert mean value.

Overall, firms' most important organizational competences focus on identification of the people that hold knowledge and strategic know-how; and pooling of knowledge from various parts of the firm. Knowledge pooling was emphasized by interviewees as optimizing existing firm resources by utilizing everyone's expertise and experience when needed in different projects. Consistent with other findings in the firm interviews, many respondents specifically highlighted exploitation of internal resources as the main source of strength in any kind of innovative activity. In most cases, they interpreted the pooling of knowledge and identification of strategic know-how within the context of their own firms, not through external links or sources.

Some firms also mentioned that even though they do not have the ability to identify outside sources of knowledge critical to their technology and innovation strategies they do have the capacity to reach out to secondary parties to secure information or establish necessary connections. Depending on the circumstances, these parties can be consultants who are often academicians, and the firm's customers. These responses reinforce the findings that internal sources of information and knowledge acquisition were generally viewed as both more common and more important than external sources or relationships to the innovation process.

In terms of organizational competencies, the issues related to training are interesting and potentially problematic. Nearly 60 % of the respondent firms noted that they have introduced both internal training programs and external training programs for their workforces. The internal training programs were associated with the continuous internal training philosophy of most of the firms. However, these programs were often not structured and they were typically offered on an informal basis. A subset of firms noted participating in external training programs, especially the organizational ones such as those offering classes on CE[59] marking procedures and patenting. Advertisements for technical training programs were mentioned, but firms screened these offerings carefully and participated in them only if they met an important need. In a majority of the cases, the contents of external program were disseminated to the relevant part of the workforce through internal presentations to employees.

Even though most firms are good at disseminating the information on existing training programs among their workers and make everybody aware of the adapted training programs (m=2.12), serious evaluation of the impact of training programs on innovation processes are not seen as a common practice or important competency (m=3.02). The link between the technology and innovation activities and skills or management training is pretty weak in a majority of the firms. Also, useful training is not

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[59] The **CE** marking certifies that a product is in congruence with the EU consumer safety, health or environmental requirements.

directly rewarded through training subsidies or monetary benefits in most firms (m=3.78). A number of firms stated that training was a reward in itself for their employees.

Technical Competencies

When respondent firms were asked to evaluate their technical competencies they valued the effectiveness and quality control of their production process as the most important (m=1.27) followed by technological evaluation of potential products (m=1.53) and processes (m=1.69) which the company is likely to produce. Almost every firm emphasized the importance of quality control in their production process as very important for themselves. Firms put more emphasis on technological evaluation of potential products over evaluation of processes, which is not surprising as product innovations are more common than process innovations among the firms. Especially after the Customs Union agreement in 1996, the policies promoting high quality production through standards and norms, laboratory tests and various certification requirements created an increased awareness on quality control and technology evaluation among the firms.

Table 6.6 Technical Competencies

Technical Competencies (% of firms)	VI	MI	SI	NI	Mean
Effectiveness and the quality control of the production	81.9	12.0	3.6	2.4	1.27
Technological evaluation of the products which the company is likely to produce	55.4	38.6	3.6	2.4	1.53
Technological evaluation of the processes which the company is likely to adopt	43.4	45.8	9.6	1.2	1.69
Carrying out a technological assessment of the company	30.1	45.8	15.7	8.4	2.02

VI: Very Important, MI: Moderately important, SI: Slightly Important, NI: Not Important
Likert Scale- 1: Very Important 2: Moderately important 3: Slightly Important 4: Not Important
Mean equals Likert mean value.

Financial Competencies

Knowing the private and public sources of finance for innovation was reported as the most important financial competency among the sample firms (m=1.82). It is very important to note that none of the firms mentioned an external private source of innovation finance as part of their product development activities. Other than their own family or other internally generated firm resources, they highlighted the TUBITAK-TEYDEB or TTGV innovation support as a key source of external finance since all were recipients of these grants and loans. Also, excluding the straightforward R&D government support program application procedures, a majority of the firms (57.8 %) do not think it is important (slightly and not important) to have a communication strategy towards potential financial partners of innovation projects.

Table 6.7 Financial Competencies

Financial Competencies (% of firms)	VI	MI	SI	NI	Mean
Anticipation of the full costs of innovation projects	22.9	51.8	20.5	4.8	2.07
Knowing the private and public sources of innovation finance	37.3	45.8	14.5	2.4	1.82
Communication strategy towards potential financial partners of innovation projects	14.5	27.7	37.3	20.5	2.64

VI: Very Important, MI: Moderately important, SI: Slightly Important, NI: Not Important
Likert Scale- 1: Very Important 2: Moderately important 3: Slightly Important 4: Not Important
Mean equals Likert mean value.

For most firms, anticipation of the full costs of innovation is related to the estimates of revenues that will be generated by the newly developed products. Unless there is a clear market, or concrete demand from customers, firms are very conservative about investing in riskier new product development projects. Once they believe in the market sales potential of new products, firms estimate the innovation project costs and then take action.

These financial competency responses show that innovation financing mechanisms are limited to TUBITAK and TTGV’s traditional support programs. Taken together these results reinforce the conclusion that private venture and seed finance for technology adoption and innovation is a rarity in the Turkish case and that the government grant and loan programs are filling a clear gap. The absence of other third party financial mechanisms was noted in the previous policy evaluation chapter. Lack of private financing mechanisms and the associated lack of culture and expertise in banking and other finance capital institutions limit financing of new product development projects to internal investment capacities of the firms and their ability to secure public matching grants and loans.

Collaborative Competences: Customers

As one of the top sources knowledge for firms, customers and clients are given high importance in firms’ product development efforts. For almost all firms; their competencies in analyzing the nature and needs of their customers were fundamental to their innovation efforts (m=1.54) and collecting the after-sales reactions of customers was essential for their further product development efforts (m=1.64). Over 89 % of the firms mentioned that they use customer feedback as a source of evaluating and changing their current product designs. The company’s innovation image is also perceived as an important factor shaping the collaboration with customers (m=1.88). However, advertisement of (50.6 %) and especially special offers (69.9 %) for new products were not identified as very important forms of interaction with customers among a large majority of firms. Consistent with other responses, this suggests that the majority of firms innovate to retain or expand their existing customer base rather than to aggressively seek new potential customers or markets. This again supports the prominence of a demand pull process for innovation in the Turkish context.

Table 6.8 Competences in Collaborating with Customers

Competences in Collaborating with Customers	VI	MI	SI	NI	Mean
Analyzing the nature and the needs of the customers	56.6	36.1	3.6	3.6	1.54
Collecting customers reactions at after-sales services or retailers	48.2	43.4	4.8	3.6	1.64
Using the product as a source of information about the customers satisfaction	51.8	37.3	7.2	3.6	1.63
Special offers for new products	9.6	20.5	16.9	53.0	3.13
Determination of the target, the media and the type of message for advertising new products	14.5	34.9	20.5	30.1	2.66
Company's innovation image	41.0	39.8	9.6	9.6	1.88

VI: Very Important, MI: Moderately important, SI: Slightly Important, NI: Not Important
Likert Scale- 1: Very Important 2: Moderately important 3: Slightly Important 4: Not Important
Mean equals Likert mean value.

Collaborative Competences: Suppliers

A crucial aspect of technological change and innovation involves interaction with and learning from suppliers of key components and technologies (Von Hipple, 1988). Regarding their competences in interacting with suppliers, the respondent firms highlighted their capacities in absorbing the knowledge and technology incorporated in equipment and components of suppliers as the most important of the competencies related to collaborating with customers (m=1.86). Obviously, the nature of supplies and equipment and the technology embedded in them vary greatly across different sectors. However, in general firms evaluate their internal capacities to understand and adapt new technologies from suppliers as greater than the competencies of the supplier firms themselves. This was especially true of the companies whose supplier base was dominated by domestic firms offering generally unsophisticated, less advanced components or equipment. The wide belief among these sample firms is that that the quality and technical sophistication of domestic supplies among firms indicates a real need for development of policies targeting supply-chain linkages and management in the NIS construction process.

Firms also affirm the importance of rapid adoption of technologically new equipment (m=2.07) and supplies (m=2.10) for their innovative activities However a number of interviewees interpret these competencies with caution as they place higher value on the reliability of new equipment and supplies than on their technological novelty. As the firms' technical competency and competitiveness increase, the emphasis they place on the rapid and effective adoption of supplies and equipment increase as well. It seems that learning from the technology provided by suppliers was prevalent mostly with foreign suppliers from the EU or other OECD countries.

Table 6.9 Competences in Collaborating with Suppliers

Competences in Interacting with Suppliers	VI	MI	SI	NI	Mean
Fast adoption of the technologically new equipment	32.5	38.6	18.1	10.8	2.07
Fast adoption of technologically new supplies	31.3	36.1	24.1	8.4	2.10
Subcontracting for acquisition of R&D	4.8	8.4	16.9	69.9	3.52
Absorption capacities of the knowledge incorporated in the innovative equipment and components	31.3	55.4	9.6	3.6	1.86

VI: Very Important, MI: Moderately important, SI: Slightly Important, NI: Not Important
Mean equals Likert mean value.

Subcontracting or acquisition of R&D from suppliers is not a common practice in Turkish industry. A great majority of the firms (69.9 %) indicated subcontracting or acquisition of R&D from suppliers as unimportant (m=3.52) and specifically stressed the lower technological and organizational competencies of the supplier firms in meeting their demands. They highlighted unidirectional flow of knowledge from the major manufacturing firms to supplier firms and emphasized importance of the major OEM firms in the supply chain, especially the automotive industry, in raising the quality of their supplier bases by increasing suppliers' design capabilities. Suppliers' importance as knowledge sources was often explained through their capacity to convey information about changes in technology in the market area of the firms acquiring components or equipment.

Collaborative Competences: Competitors

Analyzing the characteristics of competitors products (m=1.54) and knowing competitors' technologies (m=1.81) appeared as the most important competences of firms in relation with competitors. Other than these, responses in all areas appeared as either slightly important or not important. Joint ventures, various strategic alliances and forms of cooperation with competitors (m=2.61) came out as the most frequent type of collaboration – most commonly with international competitors. With respect to technology development, on the other hand, R&D alliances with other companies were almost non-existent (m=3.51) and 69.9 % of all firms specifically reported that R&D alliances with competitor firms were not important. The respondent firms also mentioned analyzing patents of the competitors as slightly important (m=2.83 The most common reason for not analyzing competitor's patent activity was a lack of significant patent activity of firms' competitors. However, as firms' interest in technology development increase, the importance of analyzing patents of their competitors' increases as well. Firms also noted the minimal importance of using external inventions of competitors such as licenses and patents (m=3.35).

Table 6.10 Competences in Collaborating with Competitors

Competences in Collaborating with Competitors	VI	MI	SI	NI	Mean
Analyzing competing products	61.4	27.7	6.0	4.8	1.54
Analyzing patents of the competitors	13.3	28.9	19.3	38.6	2.83
Knowing competitors technologies	37.3	49.4	8.4	4.8	1.81
R&D alliances with other companies	4.8	9.6	15.7	69.9	3.51
Using external inventions (patents, licenses)	7.2	15.7	12.0	65.1	3.35
Joint ventures, various strategic alliances and forms of cooperation	22.9	27.7	14.5	34.9	2.61

VI: Very Important, MI: Moderately important, SI: Slightly Important, NI: Not Important
Likert Scale- 1: Very Important 2: Moderately important 3: Slightly Important 4: Not Important
Mean equals Likert mean value.

The overall evaluation of competencies with firms shows that even though firms are cognizant of their competitors' activities in terms of knowing their product range and their existing production technologies, any collaboration with competitors in general or in the form of specific technology development partnerships is almost non-existent in domestic markets. Another important reason for the absence of pre-competitive collaborations is the perception that Turkey does not have a strong system of industrial property rights. For this reason, firms become suspicious about any kind of activity that will promote knowledge spillovers to competitor firms. They are also concerned that collaborations in R&D might involve loosing skilled personnel to competitors. The firms in this sample were therefore very conservative about protecting their product development initiatives and their production technologies.

6.5 Sources of Information and Know-How for Technological Change and Innovation

The survey results strongly suggest that Turkish firms in the sample relied on internal resources and capacities and interactions with a limited number of external sources to acquire information and know how to support their innovation projects.. A majority of the firms in the sample reported internal R&D departments (m=1.28), specialized literature (m=1.45), customers and clients (m=1.49), fairs and exhibitions (m=1.58), the Internet (m=1.63), and the study of their market (m=1.64) as the most important knowledge resources for their technology and innovation efforts. Universities and government R&D support register as significant, but not critical sources of knowledge and information acquisition. It is very important to note that among the least important knowledge resources were certain extra-firm institutions highlighted in the NIS and RIS literature focused on high income countries. Extra-firm institutions that are emphasized in much of the regional development and innovation literature including chambers of industry and commerce, competitors, marketing firms, public research institutions, corporate partners or joint ventures, and suppliers are not seen as important for this sample of Turkish firms involved in innovation and technology adoption.

Table 6.11 Knowledge Sources

Knowledge Sources	Very Important	Moderately Important	Slightly Important	Not Important	Mean
Firm R&D Department	81.9	10.8	4.8	2.4	1.28
Specialized Literature	60.2	34.9	4.8	0.0	1.45
Customers & Clients	66.3	21.7	8.4	3.6	1.49
Fairs and Exhibitions	56.6	33.7	4.8	4.8	1.58
Internet Information	47.0	43.4	9.6	0.0	1.63
Market Evaluations	45.8	45.8	7.2	1.1	1.64
Govt. Support Programs	21.7	44.6	27.7	6.0	2.18

Universities	32.5	28.9	9.6	28.9	2.35
Consultants	18.1	42.2	3.6	36.1	2.58
Suppliers	14.5	22.9	27.7	34.9	2.83
Industry Associations	10.8	16.9	26.5	45.8	3.07
Partners	24.1	7.2	1.2	67.5	3.12
Public Research Institutions	8.4	10.8	8.4	72.3	3.45
Marketing Firms	4.8	9.6	8.4	77.1	3.58
Competitors	4.8	7.2	8.4	79.5	3.63
Chamber of Industry	1.2	0.0	10.8	88.0	3.87

Likert Scale- 1: Very Important 2: Moderately important 3: Slightly Important 4: Not Important
Mean equals Likert mean value.

Other than customers and fairs and exhibitions, firms mostly mentioned codified knowledge sources such as technical literature and the Internet as important to their innovation efforts suggesting weak linkages of knowledge and information exchange with other private or public sector organizations. A majority of the firms identified universities (61.2 %) and consultants (60.4%) as very and moderately important knowledge sources. On the other hand, they viewed suppliers as insignificant knowledge sources for technological learning and innovation even though strong relations with suppliers for basic production were seen as important. Firms also reported government innovation support programs as relatively important because the project monitoring committees made-up of academicians guided the firms though their projects and in many instances they became a significant source of collaboration and feedback as they were engaged in R&D projects.

The importance that firms put on to internal R&D department, specialized literature, universities, and fairs and exhibitions and government support programs as important knowledge resources increases as firms intensify their technology development efforts. On the other hand, the importance given to customers and clients increases as firms' competency in technology development decreases. Yet, customers still remain as one of the most important sources of information for all firms.

Table 6.12 Firms' Knowledge Resources According to Their Orientation towards Technology

Knowledge Sources	Mean group A	Mean group B	Mean group C	Mean group D
Firm R&D Department	1.41	1.29	1.19	1.00
Specialized Literature	2.00	1.35	1.11	1.00
Customers& Clients	1.26	1.59	1.61	1.67
Fairs and Exhibitions	1.78	1.53	1.50	1.00
Internet Information	1.63	1.71	1.61	1.33
Market	1.85	1.47	1.58	1.33
Govt. Support Programs	2.41	2.35	1.92	2.33
Universities	3.22	2.12	1.92	1.00
Consultants	3.04	2.19	2.53	1.33
Suppliers	3.15	3.29	2.42	2.33
Industry Associations	3.33	3.18	2.89	2.33
Partners	3.22	3.12	2.97	4.00
Public Research Institutions	3.89	3.18	3.39	1.67
Marketing Firms	3.81	3.59	3.39	3.67
Competitors	4.00	3.47	3.39	4.00
Chamber of Industry	3.93	3.94	3.81	3.67

Group (A)- Firms that are not generally interested in developing new products, but are under pressure to improve or extend their existing products to meet demands of their customers and remain competitive in their traditional markets; Group (B) - Firms that are developing an interest in new product development but have limited experience and limited commitment to applied research; Group (C) -Firms that are actively searching for and developing new products based on advanced technologies that exist in global markets; Group (D) - Firms that are involved in cutting-edge technology development practices and projects, (which is usually is very rare in the Turkish context). Mean equals Likert mean value for each group.

In order to understand their future knowledge acquisition means, firms were also asked about their plans to increase their access and use of new sources of knowledge. A majority of the firms reported participation in fairs and exhibitions (92.8 %); and cultivating linkages with other actors (77.1 %) among their most important new channels of knowledge and information. Training employees internally (61.4 %) and externally

(55.4 %) were also mentioned by firms, however these figures were similar to the shares that had actually introduced internal and external training programs (both 57.8 %) during the last five years.

The distribution of data according to technology development intensity of firms, show that as firms become more competent, their inclination to cultivate linkages with other external actors does in fact increase. While only 63 % of firms less interested in technology development prioritize future collaborations, the percentages in other categories are 70.6 %; 88.9 % and 100 % respectively. This offers some support for the idea that higher levels of technological learning are required to understand the importance of, and exploit more intensive relations with extra-firm institutions.

6.6 Obstacles and Barriers to Innovations

An additional battery of structured and open ended questions asked the firm respondents to indentify key barriers to their innovation activities. In order to identify barriers to innovation activities, firms were first asked to evaluate a number of obstacles and/or hindrances in their innovation efforts during the last three years. Then, at the end of the survey-interview, they were asked to describe the three most important obstacles or hindrances to innovations within the context of their companies. In the structured question, firms emphasized unfavorable domestic macroeconomic conditions (m=1.53) as the most significant barrier to their innovation activities. Many respondents stated that especially during recessionary periods, R&D expenditures were the first to cut to provide resources for regular ongoing production activities.

> "The last economic crises in Turkey hit our company pretty hard. A big lay-off was announced including a significant number of high-paid engineers and researchers. Before the lay-off, we, the R&D department, lobbied for some

internal restructuring as we knew it was going to happen. We proposed salary reductions for a limited time, no bonuses, etc. to prevent job losses and we were successful to some extent. We engaged in this activity not only to prevent job losses but also to carry on the R&D department and culture in the firm. Because we knew, given the financial difficulties, the management could easily settle more on the conventional low-tech dyes for which there is always a big mass consumer market."

Firms identified lack of strong customer demand as the second most important obstacle to innovation (m=1.80), suggesting again that most firms may not view new innovations as having the potential to open up large untapped markets. Once again, a significant number of firms asserted that their innovation activities were dependent on the existence of a clear market that could justify the firm's investments in specific innovation projects. Related with that, high cost of developing new products and processes was identified as a restrictive but relatively less restrictive factor in firms' innovation activities.

"Unless there is a high customer demand, there is no way we could start a new research project. I think no one can afford it in this market as the uncertainties associated with R&D activities aggravate most in a fragile economy."

"You're as innovative as your customers. If your customers do not demand high-tech products and prefer the cheapest products available out there, there is no logic in investing on R&D. At the end, the fundamental objective of every firm is to make money. In our firm, with the increasing buzz on R&D, new investments were made on nanotechnology products. The management presents these as their prestige products even though they constitute only a minor fraction of the revenue. And the future of nano-products seems to be dependent on the prolonged interest of the automotive industry."

"The customer demand is the starting point of everything. Customers come with an idea we elaborate it and then finalize the process with a tangible product. The main thing here is whether we have the capacity to finish the product on time. As long as the scope of the affirmed project is within the capabilities of the firm, the management goes for it even though there are problems with cash-flow… Because they know that they're going to make money at the end."

> "For this escalator project, I got TTGV support and also sold three of my houses which by the way made my family very angry. I did it anyways because I knew that I would earn more money and buy more houses. I knew that there was a demand in the Turkish market and there were no domestic firms meeting this demand. Starting the project was risky but towards the end, we were having frequent visitors, some of which had become our most loyal customers."

> "We mostly develop what we call "sure products". We contact with seven or eight customers and try to understand the specific features they need. Accordingly we develop the new product knowing that there will be a customer for it. We also develop products that are directly funded by customers. In that case, the innovative character of the product is defined by the customer. Our most important responsibility in that case is to finish the product on time."

Firms assessed most of the other potential obstacles as not significant, including most categories of linkage or relationship with actors or institutions outside the boundary of the firm. Potential obstacles such as lack of financing, risk and investment capital (m= 3.18); lack of external technical and consultant support services (m= 3.17); lack of access to expertise in universities and higher education institutes (m= 3.35); lack of access to expertise in research institutions (m= 3.41); lack of information on research and technical programs (m= 3.20); lack of information on technology (m= 3.20); lack of networking with other firms and institutions (m= 3.46); and ineffectiveness of legal conditions supporting innovation (m= 3.49); were not identified as significant obstacles to innovation.

Table 6.13 Obstacles and Hindrances Firms Face in their Innovation Activities

Obstacles and Hindrances in Innovation Activities	VR	MR	SR	NR	Mean
Unfavorable domestic macroeconomic conditions	**56.6**	**34.9**	**7.2**	**1.2**	**1.53**
Lack of strong customer demand	**41.0**	**44.6**	**8.4**	**6.0**	**1.80**
High cost of developing new products and processes	**24.1**	**37.3**	**22.9**	**15.7**	**2.30**
Lack of qualified or skilled personnel	16.9	28.9	25.3	28.9	2.66
Lack of marketing capability	3.6	26.5	28.9	41.0	3.07
Lack of financing, investment and risk capital	12.0	12.0	21.7	54.2	3.18
Lack of external technical and consultant support services	4.8	16.9	34.9	43.4	3.17
Lack of access to expertise in universities and HEI	2.4	14.5	28.9	54.2	3.35
Lack of access to expertise in research institutions	2.4	13.3	25.3	59.0	3.41
Lack of information on research and technical programs	3.6	19.3	30.1	47.0	3.20
Lack of information on technology	2.4	18.3	36.6	42.7	3.20
Lack of networking with other firms and institutions	**2.4**	**10.8**	**25.3**	**61.4**	**3.46**
Ineffectiveness of legal conditions supporting innovation	**1.2**	**10.8**	**24.1**	**63.9**	**3.49**
Long administrative/approval procedures	**1.2**	**10.8**	**24.1**	**63.9**	**3.51**
Lack of information on government support programs	**1.3**	**1.3**	**13.8**	**83.8**	**3.80**

VR: Very Restrictive; MR: Moderately Restrictive; SR: Slightly Restrictive; NR: Not Restrictive. Mean equals Likert mean value for all in each category.

The most important obstacles with respect to new product development in Turkey come from the orientation of R&D and innovation initiatives toward existing markets and the existing structure of demand. At this phase of industrial or technological development Turkish firms do not generally undertake technology adoption and innovation projects to aggressively move into new market areas or develop new products to meet new or untapped market needs. Relatively low levels of technology and capital investment determine the structure and pace of new product development practices, and as noted, there are few private sources of venture finance available for riskier or more aggressive projects to develop new markets. The obstacles for innovations highlighted by firms mostly focus on prospects in the firms existing markets and improving or enhancing existing product lines rather than knowledge networking, IPR, or commercialization needed for generation of new products. In other words, the firms' responses overall indicate that, in contrast to emphasis put on strong networking with extra firm institutions found in the literature on NIS and RIS studies in the advanced market economies, Turkish innovative firms do not see absence of networking opportunities as an important barrier to their innovation activities.

> "The problem is not the lack of access to other institutions or programs. The problem is firms' lack of ability to organize their R&D system in the firm. This influences everything including the sustainability of your future R&D projects. In our case, developing technology is the least important component. We have highly skilled engineers, researchers, connections etc. But unfortunately, we cannot make them work in the most productive and efficient manner. We somehow cannot establish the necessary organizational routines that go beyond the current scope of the firm."

This statement suggests that there may be a set of common internal and external constraints not fully revealed in the structured question framework. The open ended question that investigated the three most important obstacles to innovations for the individual survey firms revealed some clustering of common responses and themes could be coded under 3 different categories: resources (financial, organizational, human resources and infrastructural); networking; and policy (Table 6.13).

In the context of the open ended question, the majority of the firms identified the most important obstacle for innovations as the financial resources (31.3 %) which is followed by organizational resources (24.0 %); human resources (22.9 %); networking (16.9 %); policy (10.0 %) and infrastructural resources (1.2 %).

Table 6.14 Most Important Obstacle Firms Face in Their Innovation Activities

Obstacle Categories	
1. Resources	
Organizational Resources	Lack of a well structured R&D department system; lack of long-term R&D plans and programs; uncertainties associated with R&D activities; lack of support from other departments in the firm; limited marketing capabilities; lack of knowledge on new and emerging markets; pace of technology development and limited ability to cope with pace; intensity of global competition; limited ability to cope with big-firms in international markets; pace of product development; vision of upper management on innovation (it influences pace of activities); existing business culture; existing level of education, culture, vision in the firm; ownership structure of the firm: usually problems affiliated with family-firms; lack of personnel conducting benchmarking studies; lack of relationships with consultants in foreign countries; lack of long-term planning due to macroeconomic instability; limited institutional memory.
Financial Resources	Financial constraints (especially high cost of developing new technologies), limited financial capabilities of the firms, limited financial strength to support and hire R&D personnel; limited investment on capital, production technologies; limited finance allocated to R&D activities.
Human Resources	Limited time allocated to R&D activities; less time on research more time on production related problems; limited personnel allocated to R&D activities; lack of very specialized personnel; lack of experienced and specialized personnel; lack of industrial experience; especially for electronics and software sectors: difficulty of hiring these engineers due to defense industry dominance; lack of experience in production technologies; low efficiency and effectiveness of qualified personnel; difficulties in attracting best talent to cities other than Istanbul.

Infrastructural Resources	Physical infrastructure problems (lab equipments, etc.); testing facilities; testing environment for new or improved products
2. Networking	Customer relationships; demands of customers; low customer demand to high-tech products; non-innovative market demand; lack of spatial proximity to suppliers, lack of regional R&D support mechanisms; lack of guidance of universities in new technology areas; lack of more university collaboration; lack of government policies promoting interactive relations among firms; lack of communication between industry and university; lack of joint work with competitors.
3. Policy	Limited and slow innovation financing mechanisms, inefficient government R&D support policies; lack of strategic and targeted government technology policies; lack of dynamic innovation support to attract attention of upper management; dependence on regulations generating markets; late regulations compared to other countries; low-level of industrial development in Turkey and lack of addressing industrial policies; lack of IPR protection: auditing mechanisms for copied products; fear among firms with respect to sector-specific problems; improvement of standardization institutions; lack of efficient government procurement policies.

Table 6.15 Categorization of Most Important Obstacles and Hindrances

Obstacles and Hindrances in Groups	Number	Percentage
Financial (FIN)	26	31.3
Organizational (ORG)	20	24.0
Human Resources (HR)	19	22.9
Networking (NW)	14	16.9
Policy (POL)	8	10.0
Infrastructural (INF)	1	1.2

Most firms indicated that they have limited financial capabilities to cope with the high cost of new product and process development processes and to support ongoing

R&D projects involving experienced and qualified engineers and technical workers. Limited financial capabilities of the firms was frequently mentioned as an excuse to forgo new risky projects and investment in new capital and production technologies which were fundamental for launching new projects.

Related to this, many firms noted that they had low organizational capabilities to implement a strategy centered on the development of innovative products. Organizational visions and long-term technology planning capabilities are limited within firms, especially within family firms. In most cases, firms do not have a well-established R&D system promoting long-term R&D plans and programs.

> "Everybody is talking about R&D and its importance for growth nowadays. You know… TUBITAK supports, seminars etc. Influenced by those, a lot of firms now just removed "project development" tags on the doors with "R&D" without making any substantial change on the internal organization of technology development and management."

Many firms' business models and culture are primarily directed to maintain or expand their existing customer base in light of global completion and new opportunities in international, especially EU markets. Yet, beyond these exigencies the majority of firms do not see themselves endowed with the internal investment capabilities to generate and promote globally competitive technologies as well. The relatively low technology base across industries (relative to higher income OECD countries) does not encourage firms to produce high-tech products, because many other Turkish firms or customers do not demand products with high or new technological parameters. Turkish firm's distrust in the quality of domestic firms' products accompanied with low marketing capabilities also discourages firms to start new risky projects.

> “We’re the first domestic firm that produces industrial robots in the country. I developed the core technology during my graduate study and then received government support in various forms including grants; office space in technopark, etc. The biggest challenge was though marketing and advertising of the product. Nobody believed in its quality and we literally spent two full years to convince other firms that our product was as good as its international counterparts… Government support at this point would be crucial considering that they already supported emergence of the technology.”

> “We produce mass production lines; flexible production systems. When we first heard that [name of the company- a big consumer goods company] was going to establish a factory in this industrial zone, we decided to be one of their suppliers as we knew once we got into that network we would thrive. We approached them, tried to understand what they were looking for etc.; and started working on the product. For two years, we were in deep debt, couldn’t earn a single dime.. But we trusted our product and addressed the specific features the customer was looking for. Promoting it was another story but we succeeded…”

Obstacles related with human resources mostly focused around the themes of ineffective use of high skilled workforce; lack of specialized personnel and lack of industry specific experience. Contrary to expectations based on some strands in the literature, firms did not mention high skilled workforce as a crucial obstacle against new innovative product development. Firms usually believed in the quality of their workforce but criticized the environmental factors impeding their full utilization such as the intensity of time allocated to production specific problems over research required during product development phase. Quality issue emerged mostly with respect to the experience.

> “Our engineers are very talented and highly skilled. Most of them are graduates of the best universities, such as METU and ITU, and the others have been with us for so long that they are as qualified as others. They accomplish the tasks that are given to them per se. But if you ask if they would be good enough for more advanced tasks in a new area, they would probably lack the required experience. This is not a problem specific to our firm. This is the problem of the country.”

> "We have young and highly skilled engineer team. We for sure are not using them to their fullest extent. Most of these bright kids are swamped with so many production related problems that they have limited time, energy and motivation left for doing research."

> "We're happy with our workforce. Otherwise we wouldn't be together with them. We also accept that most of them lack some specialized skills we occasionally need. To address this problem, we hired a ME graduate of Bogazici University in the past. Unfortunately, he didn't stay long with us as he said the general work load did not challenge him much."

Firms that emphasized networking related problems as the major obstacles focused on customer relations; low demands or knowledge of customers for high technology products; the problems associated with university-industry collaborations such as lack of communication between firms and universities or lack of interface organizations easing these collaborations. Lack of government policies promoting interactive relations among firms such as joint work between competitors in the name of developing a technology was also mentioned as an important obstacle.

Evaluating these open ended qualitative responses, it appears that the government support programs associated with the NIS construction process over the past decade has been crucial in stimulating firms to "get their feet wet" in launching specific R&D and technology upgrading projects. The majority of the firms find R&D support grants and loans very or moderately important within the context of their ongoing projects. However, there is little evidence that the majority of firms see their existing projects as transforming their basic strategies or their existing competitive position. Many firms mentioned the need for strategic and targeted industrial policies, and investment schemes that would expand markets for product changes or new products resulting from their R&D initiatives. The obstacles stated by firms indicate that an NIS construction process in a developing country necessitates holistic interpretation and implementation of industrial, educational and innovation policies. Governments should set their priorities and expectations clearly, design strategies to achieve their priorities; and implement them effectively. In general, these responses indicate that moving from a relatively low technical culture with little experience in developing and marketing new innovate products to a culture where innovation becomes a more common and central to the competitive strategy of firms is a long term, step by step process. In this process policy makers must closely communicate with firms, monitor progress and gaps as firms build competencies, and be prepared to redesign, discard and add new instruments as the process evolves. As noted in the previous chapter, the policy evaluation and feedback frameworks in the current NIS effort remains weak and immature.

6.7 Regional, National and International Collaborations and Embeddedness

6.7.1 Geographies of External Innovation Collaborations

In the NIS literature, private firms are accepted as the core element of the system and it is seen as crucial to understand both the micro-behavior and also the wider setting within which the firms operates (Lundvall 2007:95). As widely known, an important aspect of the wider setting is formed and defined through firms' external linkages and cooperative innovation activities. The previous sections in this chapter delineated the characteristics of the manufacturing firms engaged in innovation and technology adoption via government grants, the capabilities these firms and the barriers and obstacles they face in executing their innovation projects. This section intends to identify the geography of actors and institutions that the sample firms connect with in their innovation activities. The importance of these collaborators is explored according to their geographic locations to highlight their value for firms' learning and innovation activities in the emerging national innovation system where knowledge resources are relatively limited.

For these purposes, firms were asked to indicate the importance of the organizations providing technical expertise to them during the last five years and the firm responses clearly showed that that firms' innovation activities (as indicated through the number of collaborations in comparison to total number of firms at all geographical scales) were not strongly influenced by their interactions with customers, universities, consultants and suppliers. Firms' collaborations with customers, which are one of the most important knowledge sources, were more numerous at the national (n=61; m=1.51) and international scales (n=62; m=1.30) in comparison to regional scale (n=32; m=1.28). But as the Likert scores suggest, firms do attach high importance on these relatively few regional collaborations as proximity seems to ease the flow and exchange of knowledge with customers.. The higher numbers of collaborations with national and international customers, on the other hand, show that firms try to access to knowledge irrespective of their customers' proximity.

Table 6.16 Geographical Distribution of Innovation Collaborators

Collaborations with Customers Aggregated data (n=83)	**Number of Collaborations**	**Likert Mean**
Within Region	32	1.28
Outside Region, Within Nation	61	1.51
Outside Nation	62	1.30

Collaborations with Suppliers Aggregated data (n=83)	**Number of Collaborations**	**Likert Mean**
Within Region	22	1.94
Outside Region, Within Nation	26	1.65
Outside Nation	54	1.36

Collaborations with Universities Aggregated data (n=83)	Number of Collaborations	Likert Mean
Within Region	53	1.60
Outside Region, Within Nation	51	1.35
Outside Nation	7	1.43

Collaborations with Consultants Aggregated data (n=83)	Number of Collaborations	Likert Mean
Within Region	33	1.85
Outside Region, Within Nation	14	1.71
Outside Nation	20	1.50

In comparison to customers, firms attach less value to collaborations with their suppliers as identified in previous sections. Collaborations with international suppliers (n=54; m=1.36) appear as an important technology transfer mechanism considering that most of the export sectors in the country are more dependent on intermediate-good imports which are more likely to embody advanced technologies. Regional and national supplier collaborations are mostly evaluated based on their availability and quality and the importance attached to domestic suppliers' increases as their geographic scale extend.

The aggregated data also shows that firms collaborate with universities nationwide and value highly the contributions of these collaborations in new product development efforts (n=51; m=1.35). Firms value collaborations with universities outside the regions somewhat higher than their collaborations with local universities. Considering that all three study regions have a significant higher education infrastructure and host what are considered top flight universities, the high numbers of collaborations nation-wide represent firms' desire and ability to search for and identify key knowledge and people that can contribute to new product development efforts. As expected, firms have fewer contacts with foreign universities (n=7; m=1.43). With respect to collaborations with consultants, firms prefer collaborating first with regional consultants (n=33; m=1.85) and then with international consultants (n=20, m=1.50). But technical expertise received from regional consultants is evaluated relatively less important when compared with international, especially European consultants.

The overall evaluation of geographies of external innovation collaborations show that urban regions appear as an important scale for external collaborations with consultants and universities while national and international contexts emerge as important for collaborations with customers, suppliers and again at the national scale, universities.

6.7.2 Regional and National Embeddedness of Innovative Firms

Geographies of external collaborations and the importance attached to them show that firms engage in technical interactions with their customers and suppliers, universities and consultants and value them highly as part of their product development strategies. However, a deeper understanding of firms' embeddedness in the regional and national scales is needed for better assessment of the geographic contours of the emerging innovation systems and the collaborative environment they provide for generation of new and/or technically more advanced products. This section explores the general patterns of cooperation at the regional and national and international scales by some key dimensions including: the implementation of innovation (individualistic or interactive); inter-firm relations (competitive or cooperative), customer-suppler relations (market or preferred suppliers), supply chain (fragmented or integrated) and support infrastructure (isolated or networked) [60]. For this section firms were asked to complete a chart, which is developed

[60] For this section firms were asked to complete a chart, which is developed by Cooke (2002), to indentify systemic degrees of their innovative practices both at the regional and national scales. Firms were asked to categorize their implementation of innovations on a scale of 4 (1: High, 2: Fairly High, 3: Fairly Low, 4: Low) ranging from interactive to individualistic. Likewise, they were asked to classify their inter-firm relations from 'cooperative to competitive'; customer-supplier relations from 'preferred suppliers to market'; supply chains from 'integrated to fragmented' and support infrastructure from 'isolated to networked'. So, the mean scores are between 1 and 4. As the scores get closer to 1, they represent high interaction, cooperation, preferred suppliers, integration and networked structures. As they get closer to 4,

by Cooke (2002), to indentify systemic degrees of their innovative practices both at the regional and national scales. Cooke (2002) suggests that regional innovation systems become stronger as firms' embeddedness in the region increases and this is articulated through more interactive rather than individualistic innovation implementation processes; more cooperation/collaboration infused competitive inter-firm relations; more preferred suppliers with which transaction costs are diminished and technology spillovers are increased rather than general market suppliers; more integrated supply chain in which time transaction costs are limited and there is more harmonious order of production alignments among firms rather than a fragmented structure; and more networked support infrastructure where public and private institutions know the regional actors and provide services to support innovations in congruence with the developing innovation culture in the region rather than in an isolated way.

Firms were asked to assess their position in these categories both as regional and national actors to shed light on key features of interaction at local and non-local levels in the emerging innovation systems that nurture their new product developments. They were asked to categorize their implementation of innovations on a scale of 4 (1: High, 2: Fairly High, 3: Fairly Low, 4: Low) ranging from interactive to individualistic. Likewise, they were asked to classify their inter-firm relations from 'cooperative to competitive'; customer-supplier relations from 'preferred suppliers to market'; supply chains from 'integrated to fragmented' and support infrastructure from 'isolated to networked'. So, as the mean scores get closer to 1, they represent high interaction, cooperation, preferred suppliers, integration and networked structures. As they get closer to 4, they indicate high

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they indicate high individualism; competition; more suppliers from the general market; fragmentation and isolated structures.

individualism; competition; more suppliers from the general market; fragmentation and isolated structures.

Firms in this sample identified their implementation of innovation as fairly individualistic both at the regional (m=2.99) and national level (m=3.00), supporting the dominance of codified sources of knowledge and in-house research and development efforts in firms found in the other parts of the survey. They acknowledge interactions with universities, research institutions and consultants, but they typically "own" the innovation implementation process especially if the interactions do not take place in a mutual, continuous and sustainable form as in the case of joint research contracts. Firms also recognized inter-firm relations as fairly competitive at both scales (m=3.18; m=3.07) as cooperative relations on technology development are rare due to the aforementioned property and appropriation issues. In order to keep their know-how to themselves, firms rarely interact intensively with other firms, especially with their competitors in innovation activities. Firms noted the newly developing support infrastructure, including financial, legal, environmental knowledge services, as pretty isolated both regionally and nationally to the extent they are available and accessible to any extent (m=3.37; m=3.37).

Table 6.17 Regional and National Embeddedness Evaluation of Innovative Firms

	Regional Mean	National Mean
Implementation of innovation (interactive-individualistic)	2.99	3.00
Inter-firm relations (cooperative-competitive)	3.18	3.07
Customer-suppler relations (preferred suppliers-market)	2.82	2.55
Supply chain (integrated-fragmented)	3.08	2.95
Support infrastructure (networked-isolated)	3.37	3.37

Customer-supplier relations appeared as the only category that firms made a distinction between the region and the nation. In contrast to RIS expectations, firms in this sample had a greater preference for suppliers outside the home region (m=2.81 local; m=2.55 national). The low technology base of the country made firms to seek specialized suppliers irrespective of their locations. A typical and revealing statement in most interviews included:

> "Who wouldn't want to have his suppliers around? Unfortunately, there is no local supplier meeting our demanded product specifications".

Firms collaborated more with their preferred suppliers as the technological intensity of the products they searched for increase. For the rest, cost of the supplies was determinant. The majority of the firms also identified their supply chain as fragmented at both scales (m=3.08; m=2.95). Firms frequently mentioned that even though their supply chain is more integrated with their preferred suppliers, their first responsibility is to ensure the timely delivery of a proper product to their customers. Firms in most cases do not have the pre-planning ability to construct the integrated supply chain in a sustainable manner.

The mean values for the categories that represent the embeddedness of firms at different spatial scales suggest that firms' innovations do not emerge out of well connected relationships with diverse actors at either the regional or national scale. As firms tend to innovate in isolation the quality of the products becomes more prone to their specific capabilities. The two scale embeddedness data also shows that for the study regions, emerging innovation systems do not display a distinct regional character or degree of embeddedness outside classic local economies of agglomeration.

Regional networks or interactions do not suggest any different or distinct behavior relative to national relations outside the region. But firms tend to identify themselves as more national than regional actors as they note a need to expose themselves to more widespread innovation resources to support their innovation projects. Whether at the regional or national scale, the structural industrial and market problems associated with lower technical capacity determine the extent of firms' innovations.

6.7.3 The Problems with Exercising Collaborative Activities

The important but relatively limited collaborations of innovative firms with external organizations demand a better understanding of existing problems associated with developing interactions as the policies targeting collaborative practices can only be improved through such an understanding. In this respect, respondent firms were asked to address a number of possible problems with their ongoing collaborations with external actors.

Table 6.18 Problems Associated with Collaborative Activities

	Collaborative Activities With				
Problems with Collaborative Activities: % Reporting Problems	Universities	Research Institutions	Consultants	Other Manufacturing Firms	Industry Associations
Problems with Project Management	9.6	1.2	0.0	3.6	0.0
Budgeted Cost Overrun	8.4	0.0	6.0	0.0	0.0
Unintended Knowledge Drain	6.0	1.2	3.6	4.8	0.0
Coordination Difficulties	33.7	0.0	1.2	4.8	0.0
Different Capabilities	45.8	0.0	0.0	7.2	0.0
Confidential Relation/Secrecy	3.6	1.2	6.0	9.6	0.0
Loss of Independence	1.2	0.0	0.0	3.6	0.0
Lack of Schedule Effectiveness	54.2	1.2	0.0	1.2	0.0

The respondent firms associated most of the problems with collaborative activities in their relations with universities. “Lack of schedule effectiveness” was reported as a major problem for 54.2 % of all firms in their partnerships with universities which was closely followed by “different capabilities” (45.8 %) and “coordination difficulties” (33.7 %). Firms interpreted the lack of schedule effectiveness, different capabilities and coordination difficulties as an indication of different cultural, organizational and operational capabilities resident in university settings. According to many firms, most problems center on unresponsiveness of universities to industry needs; different work ethics and culture; inapplicable, highly theoretical, long-term, complex R&D projects; unsatisfactory previous experiences; and inadequate financial and physical infrastructure.

> “It’s incredibly difficult to find an academic to work with comfortably. I understand that they work in a different setting, they’re part of a different culture but some academics based on our previous experiences just don’t have the ability to perform things efficiently; they don’t have the ability to adjust to a predetermined schedule. They’re incredibly slow to act in fulfillment of objectives of private firms.”

> “I’m sure universities do very good basic research but it is useless for us. There is no match between our and their interests. Most of the topics that interest us make no spark for them. Most of the things that they would like to do have no economical applicability.”

> “Academics are incredibly slow! Research takes so much time and unfortunately we can’t afford it. We don’t have the luxury of trying many things over and over again as each of these trials means cease of production and loss of lots of money for us.”

> “We really would like to work with universities and our upper management is very willing for that. Unfortunately, academicians approach us with very risky, long-term research projects for which we have neither the financial nor the physical resources and capabilities.”

Other than universities, few firms noted collaborative problems with other firms mainly on the issues of confidential relations/secrecy (9.6 %) and different capabilities (7.2 %).

> "Specific to main industry-supplier relations, firms have different knowledge complexities and in-house R&D capacities. They have different professional management systems, different organizational structures, etc. When the gap between the firms on some of these issues increases secrecy appears as an important problem, as the suppliers can easily, intentionally or unintentionally, reveal project specific knowledge."

These data strongly suggest that existing efforts to improve communications and linkages among firms and universities need to be continued and expanded as in the case of industrial R&D support programs or USAMs but more integrated policies should also be adopted, new interfaces should be developed targeting these specific communication problems.

6.8 Conclusion

The aggregated data collected from firms in the three study regions reveal that the main strength of the Turkey's innovation system is a long history of building foundational science and technology institutions and policies since early 1960s. In a certain sense, the major structures and institutions are in place to accelerate R&D and innovation activity by private firms. But while the sails for the boat have been built, the winds to propel more intensive innovation remain somewhat weak. This set of firms in the interview sample is committed to innovative projects, and reasonably active in patenting. In this sense the government subsidy and support for innovation is registering some success in this set of firms and in terms of national science and technology outcome measures. However, the analysis of these aggregated firm data, clearly show that innovative practices of firms are shaped by the level of industrial development, inexperience in developing and exploiting external relationships, and difficulty finding and cultivating markets for new more technically advanced products. This in turn suggests that the construction of extra-firm institutions and initiatives to intensify interaction across elements of the NIS has not, to date, had a major effect on actual firm capacities and behaviors.

Even the largest firms or the firms with higher capabilities for research and development of globally significant technologies do not have all the resources and capabilities to compete aggressively with existing complex, leading edge technologies. Although there is a significant subset of firms engaged in innovation to improve their performance on international markets by substantially upgrading their technologies and products or attempting to develop substantially new products for new markets; most firms in this sample were focused on expanding their existing customer base rather than innovating for new and or non-traditional markets. Thus most firms in this sample undertook technology and innovation projects for minor or major product improvements. Their knowledge acquisition and R&D projects are highly contingent upon the quality of their customers and existing customer demands.

Firms do not innovate in isolation and certain external linkages are important, but innovation at this stage is very endogenous to the vast majority of the firms. Firms, use more codified knowledge resources such as the specialized literature, in-house R&D and the Internet. Customers together with international suppliers are also an important reference and source of information. External linkages with public institutions are growing and are becoming more important as they have encouraged firms to “get their feet wet” in a culture where innovation and technology upgrading were not common to most firms. External linkages with other private sector actors or institutions such as knowledge service providers, financial institutions etc., on the other hand are very weak and not seen as important.

Linkages and collaborations are at an early stage of development and exhibit certain problems and frictions. The NIS construction process moving forward must pay attention to how to build on and diversify existing linkages supporting technological change and innovation. Customer and supplier linkages are more external to the firm's home region, and in many cases to the nation. Local links are important, especially new external relationships with consultants and to some extent with universities. Moving to a higher stage of new product and new market development calls for intensifying networks and external knowledge sources and collaborations. When the sample firms were categorized in four groups based on their technology capacity and product development strategies, firms that were more engaged in new, more technologically sophisticated product development viewed external relationships as more important. Therefore, if the main objective of the NIS programs is to stimulate new product and market development, the institutions must move beyond just subsidizing firms to invest. The institutions must be engineered more to tie innovation to efforts to encourage external collaboration and to build thicker innovation networks. As noted in earlier chapters, initiatives to build "relationship networks" is commencing in the Turkish NIS. But the findings in this chapter suggest that there is a long way to go and more careful evaluation of efforts to foster collaboration is crucial at this stage.

The aggregated sample data delineated here will now be broken out by region to articulate more carefully key dimensions and characteristics of local linkages and existing strengths and weaknesses at the regional level. But this aggregated survey data clearly demonstrates that few elements of what has been characterized as regional innovations systems in the literature seem to exist in Turkey. The degree of embeddedness found in studies of certain high tech regions in OECD countries is not present in the most advanced Turkish regions. The next chapter will analyze the key dimensions and differences in innovation practices between the three study regions, highlighting more specifically urbanization and localization economies and their presence with respect to innovation potential and performance in the three regions.

Chapter 7: The Role of Regional Networks and Agglomerations in Innovations in Istanbul, Izmir and Ankara

This chapter will concentrate more directly on the regional dimension of the technology adoption and innovation processes. As noted, a large and important segment of the literature on innovation systems highlights the central role of the metro region as a locus and support system for innovation and firm competiveness. Dynamic competitive advantages stem from the knowledge and capacities residing within the firm combined with resources and knowledge bases outside the firm which can be accessed and leveraged. The importance of extra-firm resources and institutions puts into relief the possible significance of geographic concentration and proximity for innovation and competitiveness. Classic economies of urbanization are seen to benefit all firms in larger urban regions due to reduced costs of supplier matching and shared infrastructure. In addition, economies of co-location benefitting groups or firms in the same or similar industries are tied to lower unit labor costs due to labor pooling, reduced cost of inputs and localized knowledge and technology spillovers.

These classic local economies of agglomeration have been further detailed and expanded upon in recent decades, especially in the area of technology and knowledge spillovers. Positive externalities from knowledge spillovers can occur across different spatial scales, but as highlighted in Chapter 2 a large body of research has shown that innovation and learning are often stimulated by firms' incremental efforts to leverage existing stocks of knowledge within their regions. Knowledge spillovers take place through joint projects, consultations, personal contacts, workforce mobility among local firms and even gatherings where managers and workers from different firms and institutions have the opportunity to discuss their experiences face-to-face. In addition, other regional institutions such as specialized venture and other finance capital firms, legal and marketing firms specialized to local industry needs, local R&D institutions, and local development support institution have been seen as important aspects of regional agglomeration economies and innovation performance. These specific forms of knowledge spillover and specialized institutional capacity, and the density and quality of local relationships and interactions in these domains, constitute the main focus of the Regional Innovation System (RIS) approach detailed in earlier chapters.

In this chapter, I probe the regional contours of innovation in the Turkish context more deeply. In the prior chapter it was shown that the innovating firms interviewed drew on both local and national and international resources in their efforts. The interview data also demonstrated that firms in aggregate relied on internal capacity and codified knowledge sources, while relationships involving more consistent face-to-face interaction with external agents were less frequent and viewed as less important by the firms. These findings provide some circumstantial evidence that any policy attempt to establish RIS from scratch should be given some serious consideration.

Gaining a better understanding of the three economic regions investigated in this work and the regional or interregional linkages and relationships has very important policy implications for the NIS construction process in Turkey. Given Turkey's history of central government control and direction of economic and science and technology policy, there has been to date limited attention and resources targeted to understanding unique regional economic structures and building up regional policies tailored to specific regional assets or regional gaps. However, the various players in the emerging Turkish NIS are beginning to struggle with the regional dimensions of competitiveness, technological change and innovation. In particular, the examples from other OECD countries, especially the EU, are being studied and discussed with increasing frequency among policy leaders and program officers.

In this chapter, I will search for the factors contributing to and impeding firms' innovative capabilities at the regional level; benefits related to more classic local economies of agglomeration as well as specific links and relationships to local knowledge sources and specific collaborations with other local institutions. In addition, I will try to identify whether firms view themselves as being "regionally embedded" in the sense that they see regional assets and collaborations as being important their innovation activities and overall competitive positions.

After outlining the basic industrial structure and dynamics of each region- Ankara, Izmir, Istanbul - I will attempt to understand what types of interactions at different geographical scales are occurring and how the firms' evaluate the importance of these different spatial interactions efforts in their technology upgrading and innovation efforts. This will involve, in part, looking for differences in the patterns and importance of regional versus extra-regional linkages between firms located in the three regions. Gaining insights into how innovating firms leverage local agglomeration economies and rely on regional national and international relationships to foster their efforts can contribute to the emerging discussion on if more decentralized innovation policies should be designed and applied in Turkey and what specific needs or gaps more regionalized policies might address. Considering that current innovation policies in Turkey are highly centralized, but the decentralization emphasis at the planning level is burgeoning as a result of the EU integration process, it is important to assess the potential role and value of more regionally targeted innovation policies.

7.1 Profiles of Regional Industrial Structure and Dynamics in the Three Regions Manufacturing Industries

As mentioned in Chapter 3 above, the regional cases (Ankara, Istanbul and Izmir) are chosen on the basis of their dominant positions in the Turkish economy and the density and complexity of their economic and institutional relationships. In terms of the national status of these regional economies, Istanbul stands out as the primary city of the country. The city "produces almost 27% of national GDP, 38% of total industrial output and more than 50% of services, and generates 40% of national tax revenues"[61]. Istanbul is responsible for 55.3 % of total exports, and 57.9 % of total imports in Turkey. Istanbul employs 27.7 % of Turkey's manufacturing workforce within 126,393 manufacturing firms constituting 31.4 % of all manufacturing firms in the country.

Ankara and Izmir the second and the third biggest cities in the country respectively but are have much smaller regional economies in comparison with Istanbul. Izmir generates 7.5% of national GDP, 9 % of total industrial output and 10% of tax revenues. It is also responsible for 6% of total exports, and 4.1% of total imports in Turkey. Izmir's 28,718 manufacturing establishments make up 7.1 % of all manufacturing firms in Turkey. Ankara, on the other hand, generates 6% of national GDP, 13% of total industrial output and 12% of tax revenues. Ankara is responsible for 3.9% of total exports, and 9.8% of total imports in Turkey. Its manufacturing firms constitute 6.3 % of all manufacturing firms in Turkey. In is also important to note that Ankara is the seat of the national government and has a much larger share of public employment in its economic base.

[61] OECD (2008). Accessed at: http://www.oecd.org/dataoecd/1/62/40317916.pdf

In order to understand the trajectories of the manufacturing industry, the composition of the industry, as well as recent industrial growth trends are analyzed over a period of time in all three regions[62].

7.1.1 Istanbul

Istanbul's export base is specialized in the manufacturing industries of apparel (except fur); knitted and crocheted fabrics and articles; pharmaceuticals, medicinal chemicals and botanical products; other electrical equipment; plastics products; jewelry and related articles; cutlery, hand tools and general hardware; soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations; footwear; other fabricated metal products; and television and radio transmitters and apparatus for line telephony and line telegraphy in 2001[63].

Between 1992 and 2001 employment change was positive in most of the top export industries, but employment losses were experienced in manufacture of knitted and crocheted fabrics and articles; footwear; other fabricated metal products; and television and radio transmitters and apparatus for line telephony and line telegraphy. The shift of employment in each industry, as articulated by the shift-share analysis technique; could be attributed to the overall growth rate in the national economy; the growth rate of the

[62] When the research was conducted, the latest available data with respect to the composition of the manufacturing industry in the country was for the year 2001. The most recent 10 year period of the data (1992-2001) is used to calculate location quotient values and to conduct shift-share analysis in the manufacturing industry.

[63] The Location Quotient (LQ) is a ratio of an industry's share of the local economy to the industry's share of the national economy and it basically indicates whether an industry is specialized in the local economy. An increasing LQ would indicate that the regional share of the industry grows more than the national share of the industry. When an industry has an increasing LQ, then the region is becoming more dependent on the export of the industry. When the LQ decreases, then the nation is more self-sufficient on that industry and is relying less on the specific region to export the industry. The "greater than 1" values for the identified industries in Istanbul indicate that the city continues its self-sufficiency in these industries and exports rest of its production that is consumed by its inhabitants.

industry in the national economy; and the growth rate of the industry in the local economy[64].

Table 7.1 Key Export Base Industries in Istanbul

Industry Code	Total Export Employment 2001	LQ 2001	Employment Change 1992-2001	National Share	Industry Mix	Regional Share
1810	38,308	1.91	21,810	6,532	37,540	-22,263
1730	10,050	2.49	-4,804	2,400	-4,391	-2,814
2423	7,552	2.45	1,735	1,226	3,565	-3,056
3190	3,101	2.55	4,445	74	1,153	3,218
2520	2,856	1.38	3,391	784	5,182	-2,575
3691	2,795	3.07	3,154	110	3,295	-251
2893	2,733	2.69	193	462	-111	-158
2424	2,731	2.26	1,810	343	694	773
1920	2,700	2.12	-879	665	-997	-547
2899	2,573	1.53	-1,774	1,019	-358	-2,435
3220	2,520	2.13	-2,264	778	-1,989	-1,053

ISIC Rev. 3 Codes: 1810: Manufacture of wearing apparel, except fur apparel; 1730: Manufacture of knitted and crocheted fabrics and articles; 2423: Manufacture of pharmaceuticals, medicinal chemicals and botanical products; 3190: Manufacture of other electrical equipment n.e.c.; 2520: Manufacture of plastics products; 3691: Manufacture of jewelry and related articles; 2893: Manufacture of cutlery, hand tools and general hardware; 2424: Manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations; 1920: Manufacture of footwear; 2899: Manufacture of other fabricated metal products n.e.c.; 3220: Manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy.

Among Istanbul's top export industries, only manufacture of other electrical equipment and manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations increased their shares both nationally and regionally. In the meantime, all the other top export industries lost their regional shares evidencing the

[64] In Community Analysis and Planning Techniques, Klosterman calls this component the "constant-share" because it assumes a constant rate of growth for all industries. He argues that this is rarely the case, and the "shift" of employment in each industry must be accounted for, thus the "shift-share" components. The industry mix component explains the number of jobs that were created/lost in the industry in considering the difference between the growth rate between the industry (nationally) and the national growth rate. Regional shift component accounts for the difference between the growth rate of the industry in the local economy and the growth rate of the industry in the national economy and thus the number of jobs created as a result of the region's competitiveness.

shift in Istanbul's manufacturing industry to neighboring cities (OECD 2008). The manufacturing of apparel (except fur); pharmaceuticals, medicinal chemicals and botanical products; plastics products and jeweler and related articles increased their shares nationally but lost their shares regionally, suggesting loss of advantage to other Turkish regions.

The cross-match of the Istanbul's top export industries with internationally competitive sectors of Turkey (according to their strengths such as low; on the edge; and high competitive) delineates that industries that are losing share in Istanbul such as manufacture of wearing apparel (except fur); jewelry and related articles; other fabricated metal products, footwear and knitted and crocheted fabrics and articles are highly competitive for Turkey[65]. That is, the region, as the main driver of the Turkish economy needs some encouragement in certain competitive sectors, possibly with policies which influence technology levels of the sectors and hence the country. Istanbul also shows growth in some sectors with limited competitive advantage in Turkey such as electrical

[65] The competitiveness of the manufacturing industries in Turkey for a relatively similar period of time, covering the years between 1995 and 2005, are identified by Kucukkiremitci (2006) by adopting Vollrath's (1987, 1989,1991) revealed competitive advantage concept and measures. Vollrath (1991:275) reveals three measures to represent alternative definitions of revealed comparative (competitive) advantage.$RCA8^i_a = RXA^i_a - RMA^i_a$; where $RXA^i_a = (X^i_a / X^i_n) / (X^r_a / X^r_n)$ and $RMA^i_a = (M^i_a / M^i_n) / (M^r_a / M^r_n)$ $RCA9^i_a = \text{Ln}\,(RXA^i_a)$ and $RCA10^i_a = \text{Ln}\,(RXA^i_a) - \text{Ln}\,(RMA^i_a)$. Vollrath uses all these three revealed-competitive-advantage indexes to "differentiate countries that enjoy a relative advantage in a particular commodity from those that do not". In his analysis, while a positive RCA value indicates a comparative advantage, a negative RCA shows a comparative disadvantage. Kucukkiremitci (2006) reinterprets Vollrath indexes to identify competitiveness of industries in a particular country by eliminating reference group of countries. Starting with the equation, $RCA10^i_a = \text{Ln}\,[(X^i_a / X^i_n) / (X^r_a / X^r_n)] - \text{Ln}\,[(M^i_a / M^i_n) / (M^r_a / M^r_n)]$and holding the assumption that $(X^r_a / X^r_n) = (M^r_a / M^r_n)$, he ends up with the following equations: $RCA^i_a = \text{Ln}\,[(X^i_a / X^i_n)/ (M^i_a / M^i_n)]$ and $RCA_a = \text{Ln}\,[(X_a / X_n)/ (M_a / M_n)]$. When (X_a / X_n) equals (M_a / M_n), then $RCA_a = 0$; meaning that competitiveness of a particular commodity (or a sector) is neither high nor low but it is just on the border. Accordingly, when $RCA_a > 0$, the competitiveness of a particular commodity (or an industry) is high and when $RCA_a < 0$, the competitiveness of a particular commodity (or an industry) is low; respectively. By calculating RCA values for ISIC Rev.3, 4 digit industries, Kucukkiremitci (2006) identifies competitiveness of manufacturing sectors in Turkey according to their strengths.

machinery and apparatus; chemicals and chemical products; radio, television and communication equipment and apparatus; machinery and equipment; medical, precision and optical instruments, and other transport equipment. Specifically, manufacture of other electrical equipment, among Istanbul's top export industries and in which the country shows growth, has low competitive advantage vis a vis global trade partners. Considering that Turkey, as a developing country, has low competitive advantage in various high-tech sectors, Istanbul's growing share in some of these sectors strengthens its prospective status in technology development policies. Istanbul, however, needs further encouragement in top-export industries such as pharmaceuticals, medicinal chemicals and botanical products; which is declining regionally but growing nationally with specific emphasis placed on in technology insight policies.

7.1.2 Izmir

The other regional case, Izmir is specialized in the manufacture of tobacco products; plastics in primary forms and of synthetic rubber; processing and preserving of fruit and vegetables; refined petroleum products; apparel; paints, varnishes and similar coatings, printing ink and mastics; vegetable and animal oils and fats; parts and accessories for motor vehicles and their engines; plastics products; corrugated paper and paperboard and of containers of paper and paperboard.

Between 1992 and 2001 employment change was positive in the top export industries of manufacture of plastics in primary forms and of synthetic rubber; refined petroleum products; paints, varnishes and similar coatings, printing ink and mastics; parts and accessories for motor vehicles and their engines; plastics products; and corrugated paper and paperboard and of containers of paper and paperboard; but it was negative in the of manufacture of tobacco products; processing and preserving of fruit and vegetables; wearing apparel, except fur apparel; and vegetable and animal oils and fats.

Table 7.2 Key Export Base Industries in Izmir

Industry Code	Total Export Employment 2001	LQ 2001	Employment Change 1992-2001	National Share	Industry Mix	Regional Share
1600	7,388	6.29	-1,864	1,183	-6175	3,128
2413	4,247	8.83	4,750	4	51	4,694
1513	3,042	2.40	-320	615	89	-1,024
2320	1,551	3.51	695	164	-254	786
1810	1,539	1.12	-134	1,649	9,475	-11,258
2422	905	2.46	408	124	653	-369
1514	854	2.24	-605	239	-802	-42
3430	845	1.53	835	177	-177	835
2520	822	1.35	1,393	199	1316	-122
2102	624	1.85	377	109	579	-312

1600: Manufacture of tobacco products; 2413: Manufacture of plastics in primary forms and of synthetic rubber; 1513: Processing and preserving of fruit and vegetables; 2320: Manufacture of refined petroleum products; 1810: Manufacture of wearing apparel, except fur apparel; 2422: Manufacture of paints, varnishes and similar coatings, printing ink and mastics; 1514: Manufacture of vegetable and animal oils and fats; 3430: Manufacture of parts and accessories for motor vehicles and their engines; 2520: Manufacture of plastics products; 2102: Manufacture of corrugated paper and paperboard and of containers of paper and paperboard.

The shift-share analysis of the Izmir's top export industries shows that among the negative employment change industries, manufacture of tobacco products should be carefully examined as the industry is declining nationally but growing regionally. The other industries experience job loss include, processing and preserving of fruit; and vegetables and apparel. Among the top export industries which show positive employment growth, manufacture of plastics products; corrugated paper and paperboard and of containers of paper and paperboard; and paints, varnishes and similar coatings, printing ink and mastics need further encouragement as these industries are growing overall in Turkey but declining in Izmir. The industry of manufacture of petroleum products raises a red flag as the industry is shrinking nationwide but growing in Izmir. And finally, the manufacture of plastics in primary forms and synthetic rubber industry should be expanded as it not only shows positive employment growth and intense specialization but also simultaneous national and regional growth.

The overlay of the competitiveness status of sectors with the regional shift-share matrix in Izmir also shows that the top export sectors in such as manufacture of tobacco products and manufacture of parts and accessories for motor vehicles and their engines are highly competitive sectors in international markets. Among the less competitive sectors, Izmir shows growth in the manufacture of plastics in primary forms and synthetic rubber industry. Unfortunately, Turkey's plastics sector has limited competitive advantage in international markets, and highlights a potentially important role to actively engage in sectoral technology development policies in the region. As in Istanbul, the increasing share of the region in high-tech but competitively low sectors such as machinery and equipment; medical, precision and optical instruments; electrical machinery and apparatus brings forward Izmir as a potential geography to invest in regional policies targeting competitiveness of the region and also the nation.

7.1.3 Ankara

The top export base industries of Ankara, the capital city, are manufacture of structural metal products; weapons and ammunition; television and radio transmitters and apparatus for line telephony and line telegraphy; aircraft and spacecraft; bearings, gears, gearing and driving elements; machinery for mining, quarrying and construction; bakery products; printing; manufacture of articles of concrete, cement and plaster; furniture; and instruments and appliances for measuring, checking, testing, navigating and other purposes, except industrial process control equipment. The development of the key export industries of the city, especially the machinery and equipment, goes back to the early days of the establishment of the Republic and Ankara's replacement of Istanbul as the new capital city of the country. During the Turkish War of Independence, Ankara was the headquarters of the Turkish nationalists' resistance movement and it became the new Turkish capital city with the establishment of the Republic. New investments took place to accelerate the functions of the new capital city whose main industries were agriculture and livestock. The establishment of the head office of the General Directorate of Military Factories (which later renown as MKE Mechanical and Chemical Industry Institute) and some other state owned industrial enterprises such as Sumerbank and Etibank and their factories in Ankara, encouraged establishment of a private supplier base in the region. Over the years, in addition to significant government sector and employment, proximity to some central government agencies made the government a more important customer for some Ankara firms, especially the firms doing business in defense industry.

The shift-share analysis of manufacturing sectors in Ankara shows that among the top export industries of Ankara, manufacture of weapons and ammunition; machinery for mining, quarrying and construction; articles of concrete, cement and plaster; and printing should be expanded as these industries grow both regionally and nationally. Industries of manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy; and manufacture of bearings, gears, gearing and driving elements, on the other hand should be given careful attention as these industries are growing regionally but declining nationally. The industries of manufacture of structural metal products; and furniture may need support as these industries are losing their regional share in Ankara. The aircraft and spacecraft industries show a similar declining trend yet it is hard to consider these as declining industries as private stakeholders in these sectors are limited and the industry is highly important for national security purposes.

Among the top export manufacturing industries of Ankara, the manufacture of articles of concrete, cement and plaster; furniture; and structural metal products are the industries in which Turkey has high competitiveness in international markets. The competitiveness levels of these industries support encouragement suggestions of these industries in Ankara, yet strategic decisions with respect to their technology improvements rest at the hands of national decision makers.

Table 7.3 Key Export Base Industries in Ankara

Industry Code	Total Export Employment 2001	LQ 2001	Employment Change 1992-2001	National Share	Industry Mix	Regional Share
2811	3,620	6.82	1,745	277	1,547	-79
2927	2,805	8.18	921	253	388	280
3220	2,801	7.51	852	264	-675	1,263
3530	1,782	13.18	-436	263	-285	-414
2913	1,558	12.25	974	80	-84	978
2924	1,459	9.15	1,081	62	416	603
1541	1,368	2.48	-385	297	-226	-456
2221	1,261	5.16	1,390	19	145	1,226
2695	1,078	2.90	1,266	42	220	1,004
3610	949	1.81	449	187	1,787	-1,525
3312	904	7.21	-383	159	-181	-361

2811: Manufacture of structural metal products; 2927: Manufacture of weapons and ammunition; 3220: Manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy; 3530: Manufacture of aircraft and spacecraft; 2913: Manufacture of bearings, gears, gearing and driving elements; 2924: Manufacture of machinery for mining, quarrying and construction; 1541: Manufacture of bakery products; 2221: Printing; 2695: Manufacture of articles of concrete, cement and plaster; 3610: Manufacture of furniture; 3312: Manufacture of instruments and appliances for measuring, checking, testing, navigating and other purposes, except industrial process control equipment.

The location quotient and regional shift-share analysis of manufacturing industries in three case study regions were important to understand the general economic structure and dynamics of the case regions. Even though, the survey firms were not selected according to the strengths of the industries or their importance for the competitiveness of regions; the knowledge of economic structure of the regions were necessary to reach out to the companies who belonged to the industries that were both regionally important and nationally prominent in technology development and generation.

7.2 Profiles of the Surveyed Firms

Key characteristics of the surveyed firms were delineated in the prior chapter. However there are interesting similarities and differences among the firms across the three economic regions[66]. In terms of the industrial concentration of the firms in each region, the interviewed firms were distributed over the major manufacturing sectors. In Ankara and Istanbul there were more firms in higher tech sectors, Computer, Electronic and Optical Products and Pharmaceutical Products than in Izmir[67] (See Table 7.4 below).

[66] It is important to recall that the sample firms do not reflect a representative sample of manufacturing firms in the three regions. Therefore, regional differences in firm characteristics only underscore differences within this particular sample of firms which received R&D financing from the government and may help explain different patterns of local linkage and relationships among the firms. In other words we cannot say that the patterns of local relationships are typical of firms in each region, only that they are typical of the particular firms interviewed in each region.

[67] In the survey aspect of the research, 28 firms were surveyed in Istanbul. As far as the distribution of the sample is concerned, the highest concentration of firms lies in 4 sectors: manufacturing of machinery and equipment (28.6 %); computer, electronic and optical products (21.4 %); motor vehicles, trailers and semi-trailers (14.3 %); and chemicals and chemical products (10.7 %). Rest of the firms operates in the sectors of electrical equipment; non-metallic mineral products; rubber and plastic products; fabricated metal products; and pharmaceutical products and preparations. Within 29 surveyed firms in Izmir, the highest concentration of firms lies in the sectors of manufacturing of machinery and equipment (27.6 %); chemicals and chemical products (24.1 %); motor vehicles, trailers and semi-trailers (10.3%) and rubber and plastic products (10.3 %). Rest of the firms functions in the sectors of computer, electronic and optical products; electrical equipment; fabricated metal products; and food products. In Ankara, 26 firms were surveyed and the highest concentration of firms lies in the sectors of manufacturing of machinery and equipment (26.9 %); computer, electronic and optical products (15.4 %); motor vehicles, trailers and semi-trailers (11.5 %) and electrical equipment (11.5 %).

This may reflect Izmir's specialization in more traditional manufacturing sectors detailed in the regional economic profile above. In terms of firm size there is general similarity across the regions, with the Ankara sample having a somewhat larger group of firms with fewer than 50 employees. Likewise, the age of the sample firms is similar across the regions, with the exception of Ankara were the sample had a younger age profile[68].

One notable difference is the ownership characteristics, where the sample firms in Izmir and Ankara are more dominated by independent and family run firms, while the sample in Istanbul had more firms with corporate ownership, more headquarters firms and more joint venture activity. The difference in the Istanbul sample may reflect the status of this metro region as the primate city and main economic and trade center of the nation, but again we can make no confident generalizations from this sample. It is reasonable to account for the fact that Istanbul's sample firms have a more corporate form and are engaged in a greater number of international joint ventures when assessing their innovation practices and patters of regional linkages[69].

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[68] A majority of the sample firms in all regions are larger, independent family firms, established as independent start-ups by current owners. 42.9 % of the firms have more than 250 employees in Istanbul, while the percentages are 44.8 % and 38.5 % for Izmir and Ankara respectively. In terms of age, 62.5 % of the sample firms are founded after 1981 in Istanbul: 13 firms (46.4 %) started their operations before 1981; 3 firms (10.7 %) within 1981-1990; and 12 firms (42.8 %) within 1991-2006. In Izmir, 73.1 % of the firms are founded after 1981: 12 firms (41.4 %) started their operations before 1981; 10 firms (34.5 %) within 1981-1990; and 7 firms (24.1 %) within 1991-2006. And in Ankara, 72.4 % of the firms are founded after 1981: 7 firms (26.9 %) started their operations before 1981; 8 firms (30.8 %) within 1981-1990; and 13 firms (42.3 %) within 1991-2006.

[69] The current corporate statuses show that 42.8 % of the sample firms are independent firms and half of these firms are independent family firms (21.4 %) in Istanbul. In Izmir, and Ankara the percentages of the independent firms and independent family firms is higher than Istanbul. 72.4 % of the survey firms are independent firms and more than half of these firms (57.1 %) are independent family firms (41.4 %) in Izmir while 76.9 % of the survey firms are independent firms and 44.9 % of these firms are independent family firms (34.6) in Ankara. Firms that are joint ventures or that have equal partnerships with foreign firms comprise 17.9 % of the whole sample in Istanbul. The percentages are 6.8 % and 7.6 % for Izmir and Ankara respectively.

Table 7.4 General Characteristics of the Sample Manufacturing Firms

General Characteristics	Istanbul (%)	Izmir (%)	Ankara (%)
Industry Classification			
Machinery and Equipment	28.6	31.0	30.8
Computer, Electronic and Optical Products	21.4	6.9	15.4
Motor Vehicles and Trailers	14.3	10.3	11.5
Chemicals and Chemical Products	10.7	24.1	7.7
Electrical Equipment	7.1	6.9	11.5
Fabricated Metal Products	3.6	6.9	3.8
Rubber and Plastic Products	3.6	6.9	0.0
Pharmaceutical Products; Non-Metallic Mineral Products, Other Transport Equipment; Other manufacturing	10.7	3.6	15.5
Food Products; Basic Metals	0.0	3.4	3.8
Employment Size			
Less than 50	21.4	17.2	34.6
50-250	35.7	37.9	26.9
Over 250	42.9	44.8	38.5
Firm Type			
Large Firm	55.2	57.1	57.7
SME	44.8	42.9	42.3
Foundation Date			
<1950-1980	46.4	41.4	26.9
1981-1990	10.7	34.5	30.8
1991-2006	42.8	24.1	42.3
Corporate Status			
Independent Firm	21.4	31.0	42.3
Independent Family Firm	21.4	41.4	34.6
Headquarter of a Firm	32.2	10.3	11.5
Joint Venture and Equal Partnership	17.9	6.8	7.6
Types of Activities			
Manufacturing Final Products	78.6	79.3	80.8
Manufacturing Intermediate Product	42.9	31.0	30.8
Marketing	82.1	55.2	65.4

Firms' main types of business activities at the establishment level include manufacturing, management, sales, and marketing, suggesting a degree of vertical integration in all three regions. Perhaps related to the difference in firm structure, marketing is less common among the firms in Ankara and Izmir. In Istanbul, 82.1 % of the firms reported engaging in marketing while in Izmir, only 55.2 % of the firms got involved in marketing activities, and 65.4 % of the firms in Ankara. There was at least some suggestion in the open ended interviews that independent and family owned firms (more common in Ankara and Izmir) did not sharply distinguish between sales and marketing and may not have been engaged in more sophisticated corporate marketing activities (see Table 7.4 above).

The survey data indicated that more firms produced intermediate products in Istanbul (42.9 %) than the firms in Izmir (31.0 %) and Ankara (30.8 %), a finding that perhaps supports the notion that the massive regional economy of Istanbul contains a richer supplier base than in the smaller agglomerations of Ankara and Izmir. However, sample firms in all regions were active in international markets with 89.3, 96.6 and 92.3 percent of all firms in Istanbul, Izmir and Ankara respectively selling their products in international markets.

7.3 Innovative Practices of the Surveyed Firms

In understanding the product and process development efforts of the firms, the number of new products that are introduced into the market within a specific period of time reveals important information about the innovative characters of the firms as it shows whether firms are developing technologies on a consistent basis. All the sample firms in all regions introduced a new product into the market during the last three years, while 44.4 % of the firms reported that they introduced within 1 to 5 new or technologically improved products into the market in Istanbul. The figures were 37.9 % of firms in Izmir and a significantly higher 70 % of firms Ankara introducing between 1-5 new or improved products respectively. As will be outlined below this higher pace of new product introduction in Ankara is not explained by higher R&D effort or other innovation input variables and may hence be related to the younger age of Ankara firms and more recent engagement with government R&D and innovation support programs

With respect to their R&D expenditure, average expenditure of sample firms is 3.11 % of total sales in Istanbul, 3.43 % of total sales in Izmir and 13 % of total sales in Ankara[70]. However, in terms of R&D expenditures relative to total sample firms in Istanbul expanded $ 34,858 in R&D funds per employee, while in Izmir the ratio was $27,938 dollars per employee and in Ankara $14,688 dollars per employee. The significantly lower R&D/employment intensity in Ankara may be related to several factors. As noted Ankara sample firms are slightly smaller and younger and hence may be more labor intensive than more established Istanbul and Izmir firms. More speculatively, their greater involvement in government markets may involve a greater propensity to develop and test products developed elsewhere or may bring other public subsidies to supplement formal R&D spending.

[70] Among the firms in Istanbul professed to carry out formal R&D activities: 46.4 % of the firms spent less than 5 % of their sales on R&D, while a large proportion of the firms (21.4%) spent between 2-5 % on R&D activities in Istanbul. Only 3.6 % invested more than 10 % of their sales on R&D, while 7.1 % of the firms invested less than 1 % of their sales. In Izmir, 51.7 % of the firms spent less than 5 % of their sales on R&D, while a large proportion of the firms (34.5%) spent between 2-5 % on R&D activities in Izmir. 13.8 % of the firms invested both more than 10 % and less than 1 % of their sales on R&D. In Ankara, 52.2 % of the firms spent less than 5 % of their sales on R&D, while a large proportion of the firms (23.1%) spent between 2-5 % on R&D activities. 19.2 % invested more than 10 % of their sales on R&D, while none of the firms invested less than 1 % of their sales.

Some support for the somewhat unique stature of Ankara sample firms is provided by the patterns of reverse engineering reported in the firm surveys. A significant share of firm respondents declared that the practice of reverse engineering played a significant role in their product development processes. This share was 46.4 % in Istanbul, 55.2 % in Izmir and 61.5 % in Ankara firms. This again suggests that Ankara firms may be somewhat more active in further development and testing of products developed elsewhere. The highest percentages of Ankara in reverse engineering could be associated with its lower scores in performance of applied research as well.

As noted in the previous chapters the introduction of new innovative products is contingent upon more than just R&D investment and activity, but involves other changes in firm organization and activity. In the survey, firms were also asked if they had introduced new marketing techniques, changed management approach, adopted reverse engineering, or introduced any internal or external training programs for their employees. Around 30 % of the firms responded that they had introduced new marketing techniques in Izmir and Ankara, while the percentage moved up to 60 % of the firms sampled in Istanbul. The higher percentage of introduction of new marketing techniques in Istanbul is understandable as marketing was a more common activity among Istanbul firms in comparison to other regions. Also changing existing management routines were more common within Istanbul firms (28.6 %) as opposed to Izmir (17.2 %) and Ankara firms (26.9 %). This was also at least partially related to firm organizational structure because as family ownership decreases, change in existing management routines increases within innovative firms.

Internal and external employee training was also significantly more prominent in the Istanbul sample firms than in Ankara or Izmir. In the sample, 78.6 % of Istanbul firm reported active internal training programs while 67.9 % reported involvement with external training programs for their employees. These totals were lower in Izmir with roughly 45% involved with both internal and external training and in Ankara 50 % of sampled firms reported internal training and around 61% were involved in external training. These data again suggest that Istanbul firms were more focused on upgrading the skills of their workforces as a key element of technology adoption and innovation. The higher range for employee training in Istanbul may also be related to the more "modern" corporate organizational form of the sample firms and greater labor pooling type agglomeration effects in the larger Istanbul complex.

In order to understand why firms conduct innovation activities, firms were asked to indicate the importance of their reasons for conducting innovative activities as well. This set of questions tried to gain a better understanding of why firms are making changes including R&D investments, training, and management and marketing reforms to accelerate innovation[71]. Consistent with the aggregate sample findings in Chapter 6, complying with the demands of customers emerged as the most important reason for innovating for firms in Izmir (m=1.10) and Ankara (1.19). While meeting customer demands ranked very high among Istanbul firms as well, extending the firm's product range (m=1.14) and increasing product quality (m=1.18) ranked higher for firms in Istanbul. Achieving market leadership (m=1.32) and dealing with competitors at home (m=1.55) also emerged as important reasons for innovating for firms in Istanbul, while they became less important for firms especially in Ankara (m=2.15; m=2.46). These contrasts also lend more support to the idea that Istanbul firms with more corporate ownership patterns have more extensive and sophisticated motivations for technological change and innovation. They are less directly shaped by demands of existing customers,

[71] Firms were asked to assess their reasons for conducting innovative activities on a scale of 1 to 4. 1: Very Important 2: Moderately Important 3: Slightly Important 4: Not Important.

but are implementing strategies more oriented toward finding and exploiting new markets for their new and improved products. As also noted earlier, as Istanbul firms are more involved with marketing related activities, their interest in extending their product range increases and their dependence on the demands of customers declines.

The least important reasons for innovation activities in Istanbul and Izmir firms were developing more environmental friendly products or processes; and complying with local laws or standards. Decreasing processes costs also appeared as one of the least important reasons in Ankara (m=2.77). The least important reasons show that among government's demand side measures, regulations, standards and norms are not strong enough measures to make changes on innovation practices of the firms as well.

Table 7.5 Firms' Reasons for Innovating

Reasons For Innovating	Istanbul mean	Izmir mean	Ankara mean
Comply with the demands of customers	1.29	1.10	1.19
Increase product quality	1.18	1.31	1.31
Extend product range	1.14	1.28	1.54
Achieve market leadership	1.32	1.52	2.15
Deal with new competitors at home	1.57	1.55	2.46
Decrease production costs	2.18	1.90	2.46
Availability of government support	2.21	2.28	2.15
Deal with new competitors in export markets	2.29	2.00	2.42
Decrease processes costs	2.43	2.10	2.77
Comply with local laws or standards	2.43	2.93	2.65
Develop more environmental friendly products or processes	2.64	2.55	3.08

Likert Scale- 1: Very Important 2: Moderately important 3: Slightly Important 4: Not Important

7.4 Obstacles and Barriers to Innovations

In order to identify barriers to innovation activities, firms were first asked to evaluate a number of obstacles and/or hindrances in their innovation efforts during the last three years. Then, at the end of the survey-interview, they were asked to describe the

3 most important obstacles or hindrances to innovations within the context of their companies. The most important obstacles to firms' innovations in all three regions were unfavorable domestic macroeconomic conditions and lack of strong customer demand in the structured question. Lack of strong customer demand emerged as a more restrictive barrier for firms in Izmir (93.1 %) and Ankara (92.3 %) in comparison to firms in Istanbul (71.4 %), supporting the prior evidence suggesting more dependence on existing customers among Ankara and Izmir firms[72].

Table 7.6 Obstacles and Hindrances Firms Face in Their Innovation Activities

Obstacles and Hindrances in Innovation Activities	Istanbul mean	Izmir mean	Ankara mean
Unfavorable domestic macroeconomic conditions	1.39	1.45	1.77
Lack of strong customer demand	2.07	1.62	1.69
High cost of developing new products and processes	2.39	1.83	2.73
Lack of qualified or skilled personnel	2.86	2.45	2.69
Lack of marketing capability	3.11	3.24	2.85
Lack of external financing, investment and risk capital	3.14	3.34	3.04
Lack of external technical and consultant support services	3.18	3.00	3.35
Lack of access to expertise in universities and HEI	3.21	3.34	3.50
Lack of access to expertise in research institutions	3.25	3.41	3.58
Lack of information on research and technical programs	3.25	3.07	3.31
Lack of information on technology	3.26	3.07	3.27
Lack of networking with other firms and institutions	3.32	3.45	3.62
Ineffectiveness of legal conditions supporting innovation	3.43	3.48	3.58
Long administrative/approval procedures	3.68	3.34	3.50
Lack of information on government support programs	3.85	3.74	3.81

Likert Scale: 1- Very Restrictive 2- Restrictive 3-Slightly Restrictive 4-Not Restrictive

[72] The scale used for the obstacles and hindrances question was 1: Very Restrictive 2: Restrictive 3: Slightly Restrictive and 4: Not Restrictive. The percentage values that identify an obstacle/hindrance as important and/or restrictive reflect the sum of "Very Restrictive" and "Restrictive" values.

High cost of developing new products and processes was also identified as another important barrier for firms in Izmir (82.7 %)[73], Istanbul (57.1 %) and Ankara (42.3 %). Despite the emphasis on high cost of developing new products, lack of financing, investment and risk capital was only identified as a restrictive factor by 21.5 % of the firms in Istanbul, 17.2 % of the firms in Izmir and 34.6 % of the firms in Ankara, showing perhaps a lack of an institutional culture/existence of seeking financing resources other than firms' own resources in the regions.

Interestingly, lack of qualified or skilled personnel, an important obstacle as identified in many studies (Doloreux 2002; Kaufmann and Todtling 2000; Wiig and Isaksen 1998) was found as restrictive for 35.7 % of the firms in Istanbul, 55.2 % of the firms in Izmir and 46.2 % of the firms in Ankara. The significantly lower figure for Istanbul could again be related to the superior and more extensive pool of skilled labor in the much larger Istanbul complex. Also, firms did not identify access to expertise in universities and research institutions as restrictive barriers in all regions per se. However, more firms in Istanbul (28.6 %) reported access to universities as a restrictive barrier to their innovations than firms in Izmir (13.7 %) and Ankara (7.6 %). Lack of networking with other firms and institutions also emerged as a more restrictive obstacle for firms in Istanbul (21.5 %) than for firms in Izmir (10.3 %) and Ankara (7.6 %). It is an open question whether this pattern reflects more advanced firms in Istanbul being more aware of and concerned about the potential importance of university links and networking, or fewer barriers to university and networking collaboration in the other two regions. There

[73] Izmir's accent on high cost of developing products could be related with the novelty of the technologies and products that were developed as Izmir was identified as the region which introduced the highest number of products in to the market but also as the region in which the incremental and process technology changes were the highest and radical technology shifts were the lowest.

is at least some information in the open ended interviews that the former factor bets explains this regional divergence.

The open ended question that investigated the most important obstacles to innovations for the individual survey firms revealed some clustering of common responses and themes that could be coded and synthesized under 3 different categories of resources (financial, organizational, human resources and infrastructural); networking; and policy (Table 7.7, below). Lack of a well-structured R&D department and management system, problems associated with ownership structure of the firms, especially problems emerging out of family type structures; and existing business culture and vision of upper management appeared among the most important organizational obstacles in all regions.

Table 7.7 Most Important Obstacle Firms Face in Their Innovation Activities

Obstacle Categories	**Regions**		
Resources	**Istanbul**	**Izmir**	**Ankara**
Organizational	Limited marketing capabilities; Lack of a well structured R&D dept/system; Existing business culture; Ownership structure of the firm; Fast pace of technological developments (fierce global competition, etc); Dependence on partners	Lack of a well structured R&D dept/system; Lack of knowledge on new and emerging markets; Problems associated with being a family firm; Mass production-production in large quantities; Devotion of time to production related problems	Military/defense industry specific problems; Vision of upper management; Lack of a well structured R&D dept/system
Financial	Financial constrains; Inadequate R&D finance and personnel	Financial constrains; Limited capital investment	Financial constrains; Inadequate R&D finance and personnel; Limited investment in production

			technologies; High corporate taxes
Human	Inadequate R&D finance and personnel; Lack of experienced and specialized personnel	Limited time and personnel allocated to R&D activities; Lack of experienced and specialized personnel	Inadequate R&D finance and personnel; Lack of experience and capability; Limited time and personnel allocated to R&D
Infrastructural			Testing limitations
Networking	Market related problems (low customer demand, assessment of market needs, low market demand for high tech products, etc); Distance from suppliers; Lack of guidance by universities on new areas; Limited feedback from marketing firms; Lack of more firm type interface institutions	Market related problems (low customer demand, assessment of market needs, low market demand for high tech products, etc); Lack of more firm-type interface institutions	Customer relationships; Trust among firms
Policy	Lack of discretion of policy makers; Lack of strategic and targeted government technology and innovation policies; Late regulation practices compared to world experience	Lack of strategic and targeted government technology and innovation policies	Limited innovation financing mechanisms; Ineffectiveness of government innovation policies

In all three regions, a great majority of the firms identified financial constraints/limitations, together with limited R&D finance and personnel as the most important obstacles for innovations. In the structured obstacle and hindrances question, lack of external financing, investment and risk capital choice was addressed to firms to understand their use and/or need of external financial institutions such as banks, venture capitals, etc. in financing their new product development process. The high mean scores showing intensity of slightly restrictive responses in this statement supported most firms' utilization of internal, family or government resources. This relatively isolated innovation financing status of the firms supported financial constraints as the primer impeding reason in engaging new product development efforts. In Izmir and Ankara, firms specifically mentioned the limited capital investment and limited investment on production technologies as major barriers. In Ankara and Izmir, limited time given to high skilled researchers and technical workers to dedicate specifically to R&D projects was specifically mentioned as a significant obstacle to innovation projects. The organizational structure and the allocation of workload among existing workforce resulted in less-time for new innovative projects generally. Most firms, because of that problem, did not question the skill sets of their workers; rather they emphasized constraints on dedicating skilled labor new projects. Firms conveyed the time allocation problem among the most important obstacles and hindrances for new innovations, rather than the quality and experience of their human capital per se.

Market related problems, specifically the problems emerging out of relationships with customers; the types of emerging demand; the dependencies between the existence of a customer and the launch of a new project, were mentioned as barriers for innovative activities in all three regions. Lack of intermediary institutions between the firms and universities that would help build and manage relations in major technology areas were also commonly mentioned in Istanbul and Izmir. Among the policy related obstacles, lack of strategic coherence and targeted government technology and innovation policies were mentioned in Istanbul and Izmir. In Ankara, limited scope of the financing mechanisms and also the ineffectiveness of current capital access programs were highlighted as the most important barriers to innovations.

Table 7.8 Categorization of Most Important Obstacles and Hindrances

Obstacles and Hindrances in Groups	Istanbul (%)	Izmir (%)	Ankara (%)
Financial (FIN)	20.0	37.9	34.6
Human Resources (HR)	13.3	27.6	26.9
Organizational (ORG)	26.7	17.2	26.9
Networking (NW)	23.3	13.8	11.5
Policy (POL)	16.7	3.4	7.7
Infrastructural (INF)	0	0	3.8

In the context of the open ended question, the majority of the firms in Izmir and Ankara identified the most important obstacle for innovations as the financial resources (37.9 % and 34.6 % respectively) whereas the majority of the firms in Istanbul identified the most important obstacle as organizational resources (26.7 %).

7.5 Regional, National and International Collaborations and Embeddedness

A central theme in the broad innovation literature is that innovation emerges not only from the knowledge that is created by firms through their internal resources, but also from the way firms interact with external organizations and institutions. Innovation cannot be achieved in isolation, exclusively relying on firms' internal resources. This call for an investigation of the main sources of information for firms' innovation activities; location of their external collaborators; and also the value firms attach to these collaborators in their innovation efforts. What are the main sources of information for firms' innovation activities? Where are firms' innovation collaborators located? Do firms tend to collaborate more intensely with regional, national or international partners? If intra-regional collaborations are important in frequency, how embedded are regional actors in their local milieus and how systemic are local relationships and collaborations? Closer study of the significance of regional factors in technology adoption and innovation also provides insights on the potential importance of regional proximity and regionally tailored policies in a developing country context. Which regional economies of localization and urbanization do firms consider most important for their success in the Turkish context? What do these tell about the importance and shape of potential policies seeking to leverage regional leakages and relationships?

7.5.1 Sources of Information for Innovation

The data on the knowledge sources of firms broken out by region reaffirms a key finding in Chapter 6 - Turkish firm engaged in innovation projects rely mostly on their own internal knowledge and capabilities and mostly sources of codified information and knowledge including: specialized literature; the Internet; fairs and exhibitions. This again suggests that the process of technology adoption and innovation in the Turkish context does not rely on the frequent and intense associations and collaborations with actors and institutions outside the firm emphasized in the literature in regional innovation systems. The general patterns across sample firms in the regions indicates that external sources are significant and important in some cases, but the level of association and embeddedness is at a more intermediate stage reflecting the fact that experience with new product innovation and more cutting edge R&D is new and limited compared to leading global technology regions such as Silicon Valley or the Cambridge research park.

Nevertheless in the Turkish NIS construction process which has heavily promoted firm university relationships, the role of universities as a source of knowledge and expertise is significant. In Ankara 73 % of the firms found universities as important knowledge sources for their innovation activities while the share in Istanbul was 67% and Izmir, 44.8%. The fact that Izmir has a slightly thinner infrastructure of major universities and technical departments and a set of sample firms that focus more on traditional manufacturing may explain the lower importance placed upon universities. Consultants also represented the next important sources of information more than 70 % of all firms noted this, with Izmir sample firms again placing less emphasis on this external source.

Table 7.9 Knowledge Sources in Innovation Process

Knowledge Sources	Istanbul Mean	Izmir Mean	Ankara Mean
R&D Departments	**1.11**	**1.55**	**1.15**
Literature	**1.14**	**1.72**	**1.45**
Customers & Clients	**1.89**	**1.31**	**1.27**
Fairs and Exhibitions	**1.61**	**1.59**	**1.54**
Internet	**1.43**	**1.72**	**1.63**
Market	**1.50**	**1.59**	**1.85**
Universities	2.29	2.62	2.12
Consultants	2.36	3.03	2.31
Suppliers	3.21	2.45	2.85
Industry Associations	2.93	3.52	2.73
Partners	2.89	3.28	3.19
P. Research Inst.	3.29	3.69	3.35
Marketing Firms	3.50	3.59	3.65
Competitors	3.64	3.69	3.54
Chamber of Industry	3.82	3.97	3.87

The information sources data shows that even though firms greatly emphasize the importance of their own internal resources, they do utilize and find important different channels of knowledge as part of their innovation activities. The dependencies between firms and customers with respect to the launch of innovative projects as articulated in Chapter 6 highlight customers as crucial information sources in all regions. Moreover, given the less developed industrial base (relative to OECD countries) of the country, lower importance is placed on suppliers as knowledge collaborators in all regions, though Izmir puts higher importance on suppliers than the other two regions.

7.5.2 Geographies of External Innovation Collaborations

The significance of collaborations in the innovation process is rather well established in the innovation literature and placed at the core of the innovation systems approach. In order to identify the extent and importance of these collaborations, firms were asked to report their collaborations with customers, suppliers, universities, consultants, competitors, corporate group firms, partners, technical school, public research institutions, industry associations, science and technology parks, chambers of industry and commerce, marketing firms and venture capitalists located in different geographies in the last five years and were asked to attach an importance value to their collaborations within the context of their innovation processes.

Overall, firms surveyed in Istanbul, Izmir and Ankara was engaged in innovative collaborations and the results obtained clearly demonstrate that innovation takes place via interactions with customers, suppliers, consultants and universities. As shown in Table 7.10 below, there is a general degree of similarity between the geographic frequency and importance of these collaborations across the regions. The most prominent divergence is the greater frequency of within region collaborations among sample firms in Istanbul (over 47% of total collaborations). This is consistent with the much greater scale and scope of agglomeration economies and external institutions in the primate city.

Table 7.10 Geographical Distribution of Innovation Collaborators

Collaborations Istanbul	**Within Region**			**Outside Region, Within Nation**			**Outside Nation**			**Total**	
	n	%	m	n	%	m	n	%	m	n	%
Customers	15	28.3	1.27	17	32.1	1.58	21	39.6	1.19	53	27.9
Universities	20	55.6	1.60	12	33.3	1.33	4	11.1	1.50	36	18.9
Consultants	16	64.0	1.88	2	8.0	1.50	7	28.0	1.57	25	13.2
Suppliers	7	35.0	2.14	0	0.0	0.0	13	65.0	1.69	20	10.5
Total Collaborations	90	47.4	1.76	37	19.5	1.57	63	33.1	1.56	190	100.0

Collaborations Izmir	Within Region			Outside Region, Within Nation			Outside Nation			Total	
	n	%	m	n	%	m	n	%	m	n	%
Customers	6	11.3	1.33	24	45.3	1.29	23	43.4	1.17	53	27.3
Universities	14	35.9	1.79	24	61.5	1.25	1	2.6	2.00	39	20.1
Consultants	4	28.6	1.75	5	35.7	1.6	5	35.7	1.6	14	7.2
Suppliers	6	13.3	1.67	13	28.9	1.30	26	57.8	1.26	45	23.2
Total Collaborations	47	24.2	1.70	79	40.7	1.36	68	35.1	1.27	194	100.0

Collaborations Ankara	Within Region			Outside Region, Within Nation			Outside Nation			Total	
	n	%	m	n	%	m	n	%	m	n	%
Customers	11	22.4	1.27	20	40.8	1.70	18	36.7	1.61	49	21.0
Universities	19	52.8	1.47	15	41.7	1.53	2	5.6	1.00	36	15.5
Consultants	13	46.4	1.85	7	25.0	1.85	8	28.6	1.37	28	12.0
Suppliers	9	24.3	2.00	13	35.1	2.00	15	40.5	1.26	37	15.9
Total Collaborations	81	34.8	1.70	82	35.2	1.71	70	30.0	1.35	233	100.0

Within this framework there are interesting patterns and some subtle interregional differences. Collaborations with customers are the most frequent and the most important in total, consistent with the other findings in this research. Collaborations with customers within the region are less frequent, but as or more important than extra-regional collaborations. The importance of local collaboration with customers suggests at least some degree of local linkage and embeddedness in the innovation efforts of these firms. The exception is the greater frequency and importance of international collaborations for the firms in Istanbul and Izmir. This finding indicates that the sample firms in Istanbul and Izmir are more engaged in international markets and draw on international sources. Their counterparts in Ankara, perhaps more tied to central government customers are less linked to international partners.

The second most prominent from of collaboration is with universities in terms of both frequency and importance. Once again Izmir, with a smaller set of major universities and research departments exhibits fewer ties than Istanbul and Ankara. However, taken together these results do suggest that government efforts over the past decade have stimulated important relationships between universities and private firms in technology upgrading and innovation.

Collaborations between consultants and firms are less frequent and generally somewhat less important. The role of collaborations with consultant is somewhat more frequent and important in Istanbul as noted above and may be related to the more corporate and international character of Istanbul firms in the sample. Collaborations with supplies are the less frequent and important with the notable exception of Izmir. As previously noted, Izmir stands out as the only region where supplier relationships stand out as significant external ties. It is especially interesting that ties with international suppliers are so significant for firms in the Izmir sample. This might in part be explained by the prominent role of firms in the Chemicals and Chemical products sector where international value chains may be more interlinked.

The extent of collaborations in all regions shows that firms' major external relationships are with customers, suppliers, universities and consultants. The other actors of innovation systems such as public research institutions, industry associations, science and technology parks, chambers of industry and commerce, marketing firms, competitors, and partners are rarely emphasized as important innovation collaborators. International customers, suppliers and to a great extent consultants were highly valued in all regions with respect to the quality of information they bring into the innovation process, adding a new dimension to proximity and knowledge transfer discussions within the context of developing regional innovation policies in developing country settings. Institutional partners from scientific communities as in the case of universities are more confined to regions if the institutional thicknesses of the regions are high. International collaborations with universities, on the other hand were less favored as the collaboration process requires more complex organizational skills of knowledge searching and also networking.

7.5.3 Regional Embeddedness of Innovative Firms

As building blocks of emerging systems, understanding firms' embeddedness in their own regions is also important to assess whether local institutions, relationships and cultures provide unique supports for technology adoption and innovation. As the relationship between innovation and regional development became clearer, many countries adopted more technology oriented regional development policies, not only supporting local research and development institutions and activities but trying to build deeper and more durable associations between public and private sector institutions that evolve into local cultures of competitiveness and innovation (Muldur 2002). It has also been acknowledged that one-size-fits-all national policies are not effective as firms and regions have diverse characteristics and unique assets, gaps and needs (Todtling and Trippl 2005). In order to better mobilize economies of agglomeration and the innovation potentials of regions, more comprehensive and regionally tailored innovation strategies and development policies have been adopted that address firm needs within the unique local environments where they operate. In many regions, firms were encouraged to form cooperative associations and institutional clusters around certain economic activities in order to enhance their learning capabilities and the capacities of complementary institutions and actors.

In more renowned regional innovation systems supply side actors (universities, public research institutions, consultants, labor training institutions, etc.), demand side actors (local launch markets, public procurement policies, etc.) and support infrastructure actors (intermediary organizations such as technology transfer centers, techno-parks, financial institutions such as venture capitalists, industry associations, innovation relay centers, etc.) are designed to some extent to foster complementarities and synergies. To the extent that durable and effective relationships develop and evolve over the medium to long term these links and relationships can be characterized as a regional innovation system with certain features (local culture, identity, entrepreneurship, collaborations, dynamic innovation supporting market, regional administrative structure, capabilities of the regional policy makers, quality of education and training institutions, etc.) (Cooke et. al.2000). But these systems are open to the national and global economies and interactions with higher level innovation systems also influence the performance of firms and regions as well.

In poorer functioning regional agglomerations, administrative authorities are typically weak in establishing development visions and coherent strategies for regional development. Without strong leadership and coordination regions with certain gaps (such as missing some important external economies of localization and urbanization) have difficulty in building up local relationships and synergies into more integrated and durable partnerships. This section explores the sample firms' embeddedness[74] in regional institutional and organizational context and extent that regional agglomeration economies and associations and collaboration with regional partners influence the ability of firms to

[74] The history of the concept of embeddedness goes back to early works of Karl Polanyi (1947) and Mark Granovetter (1973; 1985) but economic geography has adopted and spatialized the concept since the early 1990s (Dicken and Thrift 1992, Grabher 1993) with an understanding that economic activity cannot be detached from the wider institutional and social context.

upgrade their technology and innovation performance. The objective was to understand whether firms evaluate their capacities and innovation projects as outcomes of emerging local innovation networks or more traditional technology development practices based on capacities resident within the firm and also the region. Examining elements of local agglomeration economies and the importance of deeper and more durable local relationships can provide insights on the status of learning and proximity from the perspective of the region as well.

Agglomeration economies primarily rest on the ideas of economies of scale and networking as geographical agglomerations, to a certain extent, enjoy the positive externalities from being located at the same place. Economic agglomerations reveal themselves as different types of clustering and there are systemic and structural differences between urban and non-urban clusters (Lorenzen and Frederiksen 2008). Some of the most important benefits of co-location of related firms are; 1) specialization of labor which gives rise to a local abundance of worker skills, and increasing efficiency through competition for labor among firms with related knowledge bases; 2) specialization of value-chains, networks and projects where firms use each others as subcontractors and customers when short delivery times and higher variety of products needed; 3) specialization of institutions providing services to related industries and regional knowledge base as in the forms of universities, vocational and technical schools, technology centers and other institutions that help deepening of the knowledge base and the technical culture in the region; 4) evolution of informal institutions shaping norms and values, like trust among firms, that lower transaction and time costs and increase learning efficiency.

In order to understand the importance of localization economies to the overall success of innovative firms, i.e. not specific to their newly developed products in the three study regions, firms were asked to evaluate the impacts of availability of local labor; availability of skilled labor; existing regional entrepreneurial culture (emergence and strength of new firms in related industries and their success in creating wealth, growth and employment); technical culture (availability of technology oriented education system including vocational training programs, technical school, universities and their contributions to industrial production and new firm and skill development); industrial specialization; trust among firms (the importance of trust in their regional competitive and also collaborative relations); and proximity to customers; competitors; suppliers; consultants and R&D collaborators. The most important elements of economies of co-location or localization common to all three regions are the supply of skilled labor[75], technical culture[76], industrial specialization[77] and relationships of trust[78]. These results suggest that firms do recognize and benefit from local pools of skilled labor and technical expertise and that regular association do contribute to trust and possibly lower transaction costs as suggested by the agglomeration economics literature. However, proximity to

[75] In Istanbul, 89.3 % of the firms noted availability of skilled labor as important for their success (50 % of the firms identified skilled labor as very important and 39.3 % as moderately important); while the respective percentages are 89.7 % in Izmir (3.4 % very important and 86.2 % moderately important) and 73.1 % (30.8 % very important and 42.3 % moderately important) in Ankara. The distribution of very important and moderately important responses shows that availability of skill labor are more important for Istanbul firms as skilled labor is more abundant in Istanbul.

[76] In Istanbul, 82.1 % of the firms noted technical culture as important for their success (21.4 % of the firms identified technical culture as very important and 60.7 % as moderately important); while the respective percentages are 69 % in Izmir (3.4 % very important and 65.5 % moderately important) and 42.3 % (23.1 % very important and 19.2 % moderately important) in Ankara.

[77] In Istanbul, 96.4 % of the firms noted industrial specialization as important for their success (28.6 % of the firms identified industrial specialization as very important and 67.9 % as moderately important); while the respective percentages are 58.6 % in Izmir (0 % very important and 58.6 % moderately important) and 53.8 % (11.5 % very important and 42.3 % moderately important) in Ankara.

[78] In Istanbul, 71.4 % of the firms noted trust as important for their success (25 % of the firms identified trust as very important and 46.4 % as moderately important); while the respective percentages are 58.6 % in Izmir (3.4 % very important and 55.2 % moderately important) and % 61.5 (11.5 % very important and % 50 moderately important) in Ankara. The majority of the moderately important responses in all three regions indicate that even though considerable amount of firms indicate the importance of trust in their interactions, there is still room for facilitating trust relationships for collaborative relationships.

specific external institutions and actors seems less important across the three regions. The advantages from proximity to competitors, R&D collaborators and customers seem to be of minor importance to many firms (Table 7.11, below). This is consistent with the other findings that highlight the significance of extra regional collaborations and the general reliance on internal resources, customers and sources of codified knowledge in the innovation process.

There are a few significant and interesting differences across the regions. Localization economy effects were more significant in Istanbul. For instance, the presence of an entrepreneurial culture is viewed as very important, but this factor is not seen as important by sample firms in other regions. And in Ankara, unlike other regions, the most important localization economy is concerned with proximity to suppliers, though in most cases these suppliers are identified as non-specialized or non-strategic for innovation activities yet important for firms' existing production line[79]. In comparison to other regions, firms in Izmir evaluated the importance of localization economies (especially proximity to specific external institutions) to their success less than the other firms (m=2.86) (Table 7.11).

The advantages of localization economies identified by the sample firms are the more traditional forms identified in the literature labor pooling and knowledge spillovers associated with the general technical culture and trust relationships with local institutions. However, specific proximity induced advantages that may reduce the costs of inputs or lead to specific knowledge or technology transfer from local suppliers, R&D collaborators and consultants are less prominent. Major collaborators with specific institutions seem to span geographic scales to a greater extent than anticipated in much of

[79] During the interviews, the respondent firms in Ankara stressed the importance of proximity to their customers and suppliers if any emergency arises in production or marketing/sales and hence the hypothetical convenience of having regional suppliers.

the RIS literature in advanced regions in OECD countries. The importance of localization advantages depicted in these responses raise questions about the important role of physical proximity in the process of innovations in developing countries.

Table 7.11 Importance of Localization Economies to Firms

Importance of Localization Economies to Firms	Istanbul mean	Izmir mean	Ankara mean
Technical Culture	2.04	2.31	2.54
Trust	2.07	2.48	2.54
Industrial Specialization	1.75	2.48	2.42
Availability of Local Labor	2.57	2.28	2.77
Availability of Skill Labor	1.64	2.07	2.15
Entrepreneurial Culture	1.86	3.21	2.96
Proximity to Competitors	3.39	3.86	3.52
Proximity to Consultants	2.50	3.72	2.92
Proximity to Customers	2.64	3.14	3.00
Proximity to R&D Collaborators	2.86	3.24	2.69
Proximity to Suppliers	2.43	2.62	1.96
Mean	2.34	2.86	2.68

Likert Scale- 1: Very Important 2: Moderately important 3: Slightly Important 4: Not Important

Urbanization economies, on the other hand, denote the positive externalities that firms enjoy being located in an urban area. Instead of co-location with other firms, firms benefit from existing industrial, institutional, infrastructural and cultural diversity and intensity of the urban scale. In order to understand the importance of urbanization economies to the overall success of innovative firms, not limited with their new product development processes in the three study regions, firms were asked to evaluate their location in terms of access to markets; diversity of economic activities; quality of physical infrastructure; communication networks and labor education; proximity to institutions providing services; banking and venture capital services; and cultural amenities. Across the three regions, sample firms designate classic advantages of urban scale as important to their competitiveness performance. The quality of communication networks, the physical infrastructure, and labor education and training rank high in all three regions. Access to the local market ranks very high in Istanbul and Izmir, but is less significant in Ankara[80]. It is possible that the existence of big ports in Istanbul and Izmir and the reliance on government markets in Ankara helps explain this divergence if local firms do not perceive government markets as “local”. The least important economies of urbanization are again related to the general availability of more specific services. Proximity to cultural amenities banking and venture capital services or general services were not seen as highly important to firms competitiveness in any of the three regions. The ranking by sample firms of the significance of urbanization economies show that, as in the case of localization economies, firms value traditional urban and agglomeration economies the most. Firms like to have access to good physical infrastructure as it supports the competitiveness of their production logistics and distribution and also good communication infrastructure to communicate and collaborate with partners in different locations. Good quality of labor education in all regions supported the availability of human capital, the most critical source for the innovation activities.

At the regional level, among the advantages of localization and urbanization economies, physical proximity to specific system actors were not considered crucial for the success of firms in any of the three major economic regions in Turkey. These findings were consistent with the geographic profiles of external collaborations which showed that

[80] In Istanbul, 89.3 % of the firms noted access to markets as important for their success (53.6 % of the firms identified access to markets as very important and 35.7 % as moderately important); while the respective percentages are 86.2 % in Izmir (48.3 % very important and 37.9 % moderately important) and 53.8 % (15.4 % very important and 38.5 % moderately important) in Ankara.

firms in all regions appreciated contributions of national and international collaborators, especially the value-chain collaborators, as much or more than the regional collaborators. This was true even though regional collaborations were still viewed as important for their innovative activities. These results call for a deeper understanding on the specific characteristics of collaboration and interaction of actors in order to better understand the nature of local collaboration and real degree of embeddedness of innovative firms in developing regional systems.

Table 7.12 Importance of Urbanization Economies to Firms

Importance of Urbanization Economies	Istanbul mean	Izmir mean	Ankara mean
Quality of Physical Infrastructure	2.25	1.62	2.23
Quality of Labor Education	2.04	2.03	2.50
Quality of Communication Networks	1.71	1.62	1.88
Proximity to Institutions Providing Services	2.93	3.45	2.54
Proximity to Banking/ Venture Capital Services	3.29	3.86	3.38
Diversity of Economic Activities	2.04	2.79	2.85
Cultural Amenities	3.03	3.03	3.12
Access to Market	1.57	1.72	2.62
Mean	2.36	2.52	2.64

Likert Scale- 1: Very Important 2: Moderately important 3: Slightly Important 4: Not Important

To gain some insights of the deeper nature of innovation related interactions, I again employ the embeddedness framework developed by Cooke (2002) which queries firms in developing countries to define the integrity of their innovation process on the dimensions of implementation of innovation; nature of inter-firm relations; extent of customer and supplier relations; character of the supply chain and scope of the support infrastructure.[81] Cooke (2002) suggests that regional innovation systems become stronger

[81] Cooke (2002) also uses the source of innovation dimension (regional versus global) to explain the regional embeddedness of the firms' innovation process. Unfortunately, identification of the source of innovation is very difficult to explain and majority of the survey firms in our study were unclear about

as firms' embeddedness in the region increases and this is articulated through more interactive rather than individualistic innovation implementation processes; more cooperation/collaboration infused competitive inter-firm relations; more preferred suppliers with which transaction costs are diminished and technology spillovers are increased rather than general market suppliers; more integrated supply chain in which time transaction costs are limited and there is more harmonious order of production alignments among firms rather than a fragmented structure; and more networked support infrastructure where public and private institutions know the regional actors and provide services to support innovations in congruence with the developing innovation culture in the region rather than in an isolated way.

In the study regions, the high mean scores in all categories indicate that regional embeddedness of firms with respect to their innovation activities is fairly low as majority of the firms identified their implementation of innovation as individualistic, regional inter-firms relations as competitive; customer-supplier relations as dispersed in market, supply chain as fragmented and the support infrastructure as isolated. It is demonstrated in the geographies of external collaborations section that 47 %, 24 % and 35 % of all collaborations in Istanbul, Izmir and Ankara respectively are in fact regional collaborations. However, only 32.1 % of the firms in Istanbul, 13.8 % of the firms in Izmir and 50 % of the firms in Ankara defined their innovation implementation process as interactive reflecting the tendency of the firms' to draw on internal resources and codified knowledge sources in their innovation/new product development processes[82].

defining the source of their innovations. Therefore, this category is omitted in our analysis as it did not contribute much to embeddedness discussion in the study regions.

[82] The percentages reflect the sum of "high" and "fairly high" interactive implementation of innovation responses.

Moreover, a large majority of the firms in all regions identified the relations between the firms as mostly competitive.[83]

Table 7.13 Regional Embeddedness in Innovation Process

Regional Embeddedness in Innovation Process	**Istanbul mean**	**Izmir mean**	**Ankara mean**	**Ankara Istanbul Izmir mean**
Implementation of innovation- Interactive	2.89	3.31	2.73	2.99
Inter-firm relations- Cooperative	3.07	3.24	3.23	3.18
Customer-supplier relations- Preferred Supplier	2.82	3.03	2.58	2.82
Supply chain- Integrated	3.14	3.17	2.92	3.08
Support infrastructure- Networked	3.36	3.55	3.19	3.37

** The mean scores are between 1 and 4. As the scores get closer to 1, they represent high interaction, cooperation, preferred suppliers, integration and networked structures. As they get closer to 4, they indicate high individualism; competition; more suppliers from the general market; fragmentation and isolated structures.

Even though the majority of the firms noted trust as an important localization economy feature, a local culture of trust relationships did not translate into cooperative relations between firms in technical matters. From the open ended interview information this disjuncture was mostly related to a strong desire to protect intellectual property and emerging know-how in innovation projects.

At the regional level, more than 47 %, 34 % and 50 % of the firms in Istanbul, Izmir and Ankara noted they have preferred regional suppliers whose products they integrate into their production process. The majority of the firms in all regions, on the

[83] In Istanbul, 21.5 % of the firms noted inter-firm relations as cooperative (3.6 % "high" and 17.9 % as "fairly high"); while the respective percentages are 24.1 % in Izmir (0 % "high" and 24.1 % "fairly high") and 19.2 % (7.7 % "high" and 11.5 % "fairly high") in Ankara.

other hand, search for new supplies in the market based primarily on cost factors.[84] It is noteworthy that only 20.5 %, 31 % and 38.5 % of the firms in Istanbul, Izmir and Ankara respectively identified their regional supply chain as integrated in the way firms consider their timing of production in accordance with the needs of the customers, and collaborate frequently if any problems arises, etc.

Firms also identified the support structure as more isolated and less networked at the regional level in all regions. Only 23.1 %, 6.9 % and 7.1 % of the firms in Ankara, Izmir and Istanbul respectively identified support infrastructure as highly networked.[85] Considering that innovation support infrastructures in the regions are still relatively young and developing, the sample firms were not accessing and working with multiple service providers at the date of the survey. Since new intermediary organizations such as technology transfer centers, techno-parks, innovation relay centers, financial institutions such as venture capitalists, law firms or offices specialized in innovation and entrepreneurship issues are just being formed existing collaborations with these institutions were mostly noted as isolated and far from systemically embedded. Majority of the firms defined major components of support infrastructure as TEYDEB, TTGV and KOSGEB innovation funds, innovation funding consultants that help firms prepare applications for TEYDEB, TTGV and KOSGEB funds and patent consultants. But sample firms had not developed important relationships with the newer elements of the NIS in a systemic way.

Broadly speaking all three study regions are endowed with most of the specific institutions and actors alluded to in the RIS literature. Of course Istanbul as the dominant

[84] In Istanbul, 46.4 % of the firms noted they have preferred suppliers (7.1 % “high” and 39.3 % as “fairly high”); while the respective percentages are 34.4 % in Izmir (3.4 % “high” and 31 “fairly high”) and 50 % (19.2 % “high” and 30.8 % “fairly high”) in Ankara.

[85] None of the firms in all three regions identified the support infrastructure highly networked. The percentages reflect “fairly high” responses.

primate city has a significantly higher degree of agglomeration advantages and institutional thickness than Izmir or Ankara. Specific local linkages and relationships are important but extra regional relationships remain crucial to the innovation process. As this section demonstrates durable and systemic collaborative practices among regional actors remain quite limited at this stage of technological development in Turkey. Firms typically do not assess their innovation processes as contingent upon systemic regional collaborations and firms' innovation practices reflect higher national and international influences overriding the advantages rising from proximity to major local actors and institutions. The limited scope of collaboration partners (mainly customers, suppliers, consultants and universities) also suggest a room for improvement in designing policies to increase interactions with institutions that specifically address gaps identified by these innovating firms (such as financial institutions, technical assistance providers etc.) to strengthen the firm's capacity to implement strategies based on technology upgrading and new product development.

7.6 Conclusion

The economic profiles and trajectories of the regions in the first section of the chapter clearly demonstrate that there are significant agglomeration economies of manufacturing industry in all three regions. Istanbul produces almost one third of the national GDP and hosts more than one third of all the manufacturing firms in the country. Economic diversity in the region is huge and Istanbul's export base is specialized mostly in the manufacturing industries of wearing apparel; pharmaceuticals, medicinal chemicals; other electrical equipment; plastics products; jewelry and related articles; cutlery, hand tools and general hardware; footwear; other fabricated metal products; and television and radio transmitters and apparatus for line telephony and line telegraphy. Ankara and Izmir are the second and third most industrialized cities in the country, but they have considerably smaller regional economies in comparison to Istanbul. Ankara and Izmir produce about 6-7 % of the national GDP and again host about 7 % of all manufacturing firms in the country. Ankara, the capital of the country, specializes mostly in the industries of manufacture of structural metal products; weapons and ammunition; television and radio transmitters; aircraft and spacecraft; bearings, gears, gearing and driving elements; machinery for mining, quarrying and construction; and furniture. And Izmir specializes mostly in the manufacture of tobacco products; plastics; plastics products; refined petroleum products; wearing apparel; paints; and also parts and accessories for motor vehicles and their engines. These three regions, compared to most of the other regions in the country, have significant institutional thickness and host various organizations that are considered crucial in properly functioning innovation systems.

The case study regions were used as units of analysis to understand the scope of interactions among innovation actors within the developing national innovation system in Turkey. The regional analysis intended to answer the main research questions of how present and deeply embedded are components of innovation systems among innovative manufacturing firms in the main Turkish economic regions. In this respect, both the commonalities and the differences of the firms in different regions were sought to explain existing strengths and capacities at the regional level to the extent they inform the developing national innovation system policies.

Within the context of the innovative practices, the commonalities of the firms in all three regions show that firms are highly engaged in product and process innovations and the innovation practices of firms in all regions exhibit similar behavior as far as innovation practices and the sources of information. As the systems of innovation approach suggest, firms rely on a variety of different information sources to build know-how, but generally rely upon their internal and codified sources the most to carry out innovation and technology adoption projects. The majority of the sample firms continue to encounter significant financial, human capital and organizational and networking barriers in their innovation process.

Firms also collaborate with regional, national and international institutions which define their innovation process as multi-scalar. But most sample firms did not perceive these interactions as systemic and integrated at the regional level. Innovative firms appreciate access to quality collaborators and reliable low cost suppliers regardless of regional proximity. Cooperation with customers, suppliers, universities and consultants stand out as important associations, while collaborations with industrial associations and marketing firms remain rather weak. Specific relationships with a variety of newly developing institutions such as technology transfer organizations, venture capital firms, and patent consultancy firms, etc. remains underdeveloped.

The regional patterns of co-operative relations in the innovation process are striking in the sense that firms rely on different actors and institutions based upon specific needs. If regions do not have sufficient resources or knowledge bases in the innovation process, firms, endowed with certain capabilities, often need to co-operate with national and international actors. As shown in Ankara and Istanbul, even though these regions host the best universities in the country, firms search for their specific needs in other regions and consider these external links as critical in their innovation process. Likewise, firms in Izmir attach the highest value on the technical expertise they receive from other institutions to customers in Europe and Istanbul, highlighting the value of out-of-region resources for them. So, regions are characterized by a highly embedded set of institutions and at this stage of technology development they remain dependent on links to the outside world. The findings in this chapter strongly suggest a re-evaluation of the "spatial" dimension of RISs in more recently industrializing countries, especially since learning and innovation take place at all levels of production and geography (Malerba 2002). A better understanding of the role of proximity in the current context of technology development and innovation is essential given the recent emphasis on cluster-based innovation policies in Turkey. The key question is how to better calibrate the newly developing support institutions with the specific needs of regional firms. In certain instances the further development of local institutions and ties will be crucial to support the further evolution of the innovation process, but in other cases extra-regional ties should not be duplicated or replaced but instead should be encouraged.

Chapter 8: Conclusion

The fundamental objective of NIS policies and programs is to enhance a country's innovative and technological capacity. The NIS framework is built upon the now commonly accepted premise of contemporary growth theory that technological improvement and growth in human capital are the key drivers of national growth and development. The focus of the NIS approach is an inquiry into how public and private institutions can be built and changed to increase a nation's capacities to search, acquire and absorb new technologies. In developed countries, these questions are directed at how advanced market economies maintain and also improve an established level of economic competitiveness and growth. In developing countries the questions are more related to how the build-up of national science and technology capacities can change the behaviors and performance of firms to affect a "catching-up" process vis-à-vis the leading market economies. It is therefore especially important to figure out how learning takes place or how well the developing system addresses and manages its primary functions of creating new knowledge, human capital, and new technological products and opportunities.

Why is the NIS framework potentially the most powerful and illuminating approach to the study of "catch-up" processes based on improving technology adoption and innovation in the context of a developing country? The literature offers many different frameworks and models that might be applied to this issue. First, this framework is rooted more deeply in evolutionary economics studies how technological change and innovation as shaped by a complex ensemble of law, policies and institutions that are built up over time and evolve within a nation state. Key system components are diverse and include legal standards affecting property rights, technical standards, education and training institutions, firm and industrial research and development activities, direct public investments in R&D, institutions supporting technology diffusion, government research priorities and institutions and so on. To understand in a sophisticated way the shortfalls and gaps which may be impeding technological development in a middle-income country, all of these elements must be in play and understood. The NIS framework carefully delineates the complex institutional set up in a particular nation, but is especially concerned about how the components interact and evolve over time to foster the accumulation of technological and innovative capacities.

Second, in a country engaged in the construction of a set of institutions and relationship that can significantly shift the technological trajectory, how the system is implemented and how interactions evolve is central. The effective running of the system, the art of co-existence of many units and agencies working toward similar objectives and learning to achieve them, depends in important ways on the ability of governments to design policies that nurture the quality of interactions among institutions. Different national histories, patterns of intergovernmental relations and institutional set-ups shape patterns of interaction and cooperation. These factors were certainly shown to have influenced the construction of the Turkish NIS components and they way the components are working or not working in the overall project.

Finally, this dissertation research highlighted how the applicability of the NIS framework to lower and middle income countries requires a specific understanding of the status of technological change and innovation given the level of industrial, technical and educational development in a country. A noted advantage of the NIS approach is that it assumes that context matters greatly and national efforts to change technological performance cannot be drawn from a recipe list or “reverse engineered” from experiences in advanced economies. Mature public and private institutions that make up systems in advanced market systems generally do not exist or exist in very weak or fragmented forms that exhibit limited interaction among public and private sector institutions (Intrakummerd et.al. 2002, Alcorto and Peres 1998, Radosevic 1998, Viotti 2002, Shulin 1999). But to date the fifteen year effort to construct NIS elements and foster knowledge building interactions between the elements necessitate has been durable and has had some meaningful and impressive payoffs.

This dissertation set out to address one important criticism of NIS studies. As noted in the second chapter, some scholars have argued that most studies in the NIS tradition focus on historical, national, industrial and institutional development processes but do not adequately account for, and empirically measure the extent and scope of interactive relationships evolving within unique national institutional and economic contexts. The integrated multilevel research approach used in this work enabled the study of NIS construction processes through the eyes of policy makers, bureaucrats, analysts, as well as the R&D personnel and firm mangers in Turkish companies. In most cases the importance of inter-institutional interactions was studied and appraised. In addition, by analyzing firm interactions and relationships in their innovation efforts at both the national and regional scales, I could provide important insights about the importance of regional processes to the direction and performance of the NIS construction process. Specifically, the information developed in this research allows some assessment of the status of regional processes, specifically the relationship between proximity and learning processes by informing the scope and scale of firm level collaborations in a developing country context. In sum, I would argue that this work advances previous NIS studies by measuring the existence and strength of collaborations, measured according to perceptions of key innovating figures at different geographical scales among firms and support institutions.` I will now turn to discuss the key findings of this work as they related to my main research questions.

8.1 Review of Key Findings

8.1.1 How Does History Matter in Applying the NIS Framework to the Turkish Case?

At the beginning of this work I posed the question what is the historic role of central government in supporting technological development and innovation in Turkey. The long-term historic pressures of maintaining the Ottoman Empire and then establishment, restructuring and modernization of the new Republic have made the Turkish central state a dominant actor in the Turkish case. The central government has been, and remains the dominant public sector actor as there has never been a strong or meaningful effort to decentralize to sub national jurisdictions. In the Ottoman Empire the indigenous manufacturing industry was developed primarily to meet the demands of the military and the ruling elites. The "ethnic division of labor" and the dominance of minorities and foreigners in industry and trade in the Ottoman Empire created major adjustment costs for the newly established Republic after the demise of the Empire. Many minority owners and managers of industrial and trading companies left or fled the country between 1910 and 1930. This meant the loss of a valuable accumulated base of knowledge and trade relations that severely hobbled the early industrialization drives in the Republic. A general lack of experience in modern production methods and modes of commerce in a largely agrarian society appeared as a serious challenge for the new state that set industrialization and economic modernization as its primary objectives. Turkey as a lagging county with major structural and social obstacles, created a backward status for Turkey relative to rapidly modernizing European powers that has persisted into the current era.

The industrialization objectives of the Republic revolved around the desire to build a modern secular state comparable to what it saw as its European counterparts. The

Republican government first adopted liberal and then etatist principles to achieve industrialization objectives. In the etatist era, in order to nurture and protect domestic private industry, the state restricted entrance of foreign investors in to the country and also encouraged domestic production of inputs that used to be imported by the enterprises. To build up indigenous primary and capital goods sectors it established and operated SEEs (State Economic Enterprises) which were equipped with imported modern technologies that fueled the economy by generating growth and achieving rapid development in targeted industrial sectors. Until the beginning of the World War II, etatist policies generated positive outcomes. But, because of the massive disruption of the war years and internal political turmoil, Turkey replaced its state directed heavy industrialization vision with private sector liberalization and agricultural and infrastructural development. The planning ideals and strong central government steering of the etatist era were left behind and more liberal, market based development of investment projects were adopted which were mostly funded through foreign borrowing.

In the rebirth of liberal policies the focus of government policies turned to upgrade the capabilities of the private sector and encourage the development of new markets for Turkish private enterprise. However, post war policies involved major swings in industrial and trade policies. In the immediate post war years, State Economic Enterprises continued to play a major role in the production of capital and intermediate goods while private sector grew more on the basis of an expanding consumer goods sector. After 1960s, with the establishment of the State Planning Organization, the government introduced an import-substitution oriented development strategy (1960-70) which prioritized mobilizing available industrial capital through restricting international purchases and increasing domestic sales within a protected environment. The import substitution based development policies had significant success in achieving substantial growth and industrialization over a 20 year period. Industrial growth averaged 6% per annum between 1960 and 1980. However, the expected transformation in the economic structure to higher levels of international competitiveness was not achieved as the quality and pricing of manufacturing goods did not reach the expected standards in international markets.

After the second oil shock in 1979, the military government that took over in 1980 and emphasized reducing the state role in the economy. The newly elected government adopted an export oriented growth strategy in which the government used generous subsidies to promote exports. Efforts to increase export markets mostly relied on more traditional mechanisms including devaluations and export incentives that did not improve the productivity and technological levels of Turkish industries in relation to world markets (Rodrik, 1995). In this period no programs or incentives were put in place to upgrade technology or upskill the workforce.

A second question that was asked at the onset was what level of national and technical and industrial development was achieved by the end of the 1990s under numerous post WWII government technology and innovation planning initiatives? During the early 1990s the objective of diversifying the export base through expansion into medium and high-tech products did not generate the expected transformation in the production structure. However, these years were identified with major macroeconomic instabilities and major crises. While GDP per capita grew 33% between 1980 and 1990, it only grew 19 % between 1990 and 2000. By the 1990s it was clear that Turkeys' backwardness had been ameliorated but not overcome. The remained a relatively poorly developed capacity in the private sector for technology adoption and entry into higher end markets. Despite numerous plans and policy pronouncements in the 1970s and 1980s, the central government economic agencies were increasingly out of touch with rapidly changing technologies and patterns of international production.

The seriousness of these problems became more intense when Turkey signed important international agreements such as GATT (elimination of export subsidies) and Customs Union (travel of goods without ant custom restrictions). The signing of the Customs Union Agreement with the European Union in 1996 strongly influenced the competitive environment that manufacturing industries were faced with. Most enterprises in order to compete with the high-tech more efficient European producers in both domestic and international markets were forced to find ways to upgrade their production capabilities by investing in newer technologies. The fast paced technological developments in newly industrializing countries and commitments to new international agreements encouraged institutions in the central government to start a serious program backed with real resource commitments to support R&D activities of the firms which later became the core of the NIS building process in Turkey.

Setting precise dates for the beginning of the NIS building process is pretty hard but the EU integration project in the mid-1990s with planned entry into the Customs Union and subsequent initiatives was definitely the key ignition factor in the process. The trade openings and other agreements on standards put into sharp relief the need for a serious focus on science and technology policy backed with real public sector investment to compete against European firms in higher value added and more technologically advanced product and service markets. However, at the dawn of the NIS construction process there was a long legacy of public sector ambivalence. Historically, there was limited experience and trust in regards to public and private sector collaboration in advancing the adoption of new technology or the pace of innovation. The development of a systematic science and technology strategy at the dawn of the 21st century did finally involve a focus, and real resource commitments, to a coherent NIS construction process. While this process was launched in a very challenging environment shaped by the long term history of Turkish development, the long history of assertive and "uncontested" central government action also helps explain how the components of the NIS were put into place over a relatively short period of time.

8.1.2 What are the Distinct Planning and Policy Initiatives that were Implemented to Built the Turkish NIS and What are the Strengths and Weaknesses of the System to Date?

After much discussion and limited action, the first comprehensive science and technology plan "Science and Technology Policy: 1993-2003" was adopted and then converted into specific action plans unlike before. This was the first time science and technology policy was prioritized in national economic policy and received the attention and investment commitments to push change. For instance, TUBITAK initiated an industrial R&D support program in 1995 which later became one of the core components of developing NIS. Following this Plan, next five year development plans introduced new strategies, the implementation of which were scrutinized through mid-term and implementation plans and other strategic documents such as "Vision 2023: Science and Technology Strategies", "National Science and Research Strategy: 2005-2010", "National Innovation Strategy: 2008-1010" and "International Science, Technology and Innovation Strategy: 2007-2010" (See Chapter 4 for details). To accomplish the objectives of the national innovation strategy plan, the government, for the first time, made a substantial commitment to build up the national science and technology base with $1.5 billion budgeted for the initiatives in the strategy in 2008. The increased R&D

funding resources supported a number of policy instruments and programs that constituted the foundation of the NIS.

In terms of the expected outcome of NIS initiatives, improvements in basic outcome measures of science and technology performance was the primary evaluative standard. This view of science and technology policy success has some validity because basic capacities have to be built up in public and private sector institutions and basic experience in integrating ongoing research and development into actual technology upgrading and innovation activities is a necessary foundation for the further evolution of the NIS. However, development of collaboration fostering policies is also necessary to animate the newly developing innovation systems. This leads to the more serious and coherent series of plans and initiatives to improve the nations technological and innovative capacities that have been developed and implemented over the past decade.

There is a consensus in the literature that the establishment and rapid evolution of technology adoption and innovation practices is dependent on how countries can successfully design and implement programs that encourage co-evolution and collective learning among innovation system actors. The innovation system construction process was led in the first phases by a select set of central government institutions including TUBITAK and DPT. As the interviews with policy and program leaders showed, the specific institutional roles and programmatic responsibilities are evolving and changing as different agencies and departments claim turf and resources. But the interviews also suggested that public institutions were learning and improving their capacities to stimulate technological change and innovation in specific areas and segments. It is possible to say that in general a learning culture is operative on some level and that the NIS construction process is changing and evolving as shortfalls and unmet needs are identified and addressed.

This study focuses on about a 14 year period (1995-2008) beginning when the Turkish state first developed a coherent strategic vision to accelerate growth in technology development and innovation in response to strong international trade pressures. The density and diversity of programs and institutions, filling virtually every area or element in common NIS model diagrams, have developed in a rapid and relatively systematic manner. Structures have been developed in the legal area, in numerous areas of R&D support and tax subsidy, in an array of technical support and assistance areas, in firm-university collaborations and partnerships, and in spatially based technoparks and business incubators. Services are directed to numerous industrial sectors, to large and small firms, and to entrepreneurs and business startups. Indeed, the rapid and relatively coherent development of public institutions and the implementation of specific programs in all areas of the NIS system is an important finding. As expected, certain institutions are more dominant, holding many responsibilities ranging from technology and innovation policy making to program implementation such as allocating R&D grants to firms as in the case of TUBITAK. However over the 2004-2008 years, other agencies identified gaps such as seed capital for start-ups and smaller firms, intermediary services to improve university-firm collaborations, and technology relay centers at universities. Again the fact that most of these institutions, programs and projects were developed and implemented over the past decade is surprising. And even with all the problems identified by interviewees, there appears to be a degree of coherence in the overall structure and business participation has been, in most cases, strong.

In addition, the institution building and public investment associated with the NIS construction project has clearly been associated with positive movements in key national science and technology indicators over the period. Growth in various categories of R&D, especially private sector R&D investment was relatively robust. This corresponded to an increase in R&D personnel and the production of scientific articles. Most significant was the relatively strong increase in patenting activity that was associated with positive movements in other indicators. While there is almost no evaluative data tying various policy changes and program interventions to these aggregate science, technology and innovation indicators, it can be said that the change in government commitment and the change in the environment related to NIS construction did contribute to a move toward more technology based growth over the past decade.

One of the key questions outlined in the first chapter was what are the major difficulties and problems confronting policy makers in their efforts to build a more effective national innovation system? The analysis and interviews with key NIS actors uncovered problems and ongoing challenges. There was evidence that as more government agencies carved out a role in the NIS, fragmentation and overlap has become a growing problem. For instance, certain programs run by KOSGEB, TTGV and Ministry of Industry and Trade, started more to resemble each other. Similar problems started to be addressed by multiple agencies, or same firms started to be supported by various institutions without any selectivity in terms size, industry or specific R&D needs. In some cases, the fragmented structure was even evident within organizations belonging to the same agencies as in the case of business incubators of KOSGEB, where firm acceptance and program goals were disconnected from each other. A collective systems perspective among similar program implementers is very weak and fragmented.

As several of the respondents phrased it, there were major problem with "systemness" in the current phase of NIS construction. Systemic-identity awareness was mentioned with respect to how system actors define their role in a functioning NIS and how their bureaucratic culture permits collaboration with other organizations especially with respect to reorganization of existing programs and needs. The lack of a performance or outcome based culture in the public sector, limited policy making and implementation capabilities and the lack of systems perspective on technology related problem identification and solutions were seen as ongoing barriers to the evolution of the NIS in Turkey.

A related criticism emerging out of the interviews and analysis were directed to both strategic goals and elements and more tactical issues of program design and implementation. At the strategic level the most prominent concern was the detachment of the NIS construction process from any coherent industrial strategy. Tackling industrial objectives such as increasing the competitiveness of current or potential export industries through a broader science and technology framework was seen as a major flaw in the national strategy by the agency and program leaders. The core assumption is that if the state invests in science and technology assets at the national level, the general competitiveness of the country will increase. On the other hand, the literature on the rapid-innovation based growth strategies (Breznitz 2005) shows that states' commitments and support in certain sectors differentiate competitive status of countries in global production networks. As several commentators noted, a more sophisticated industrial targeting and linkage strategy could also limit overlap and redundancy among programs. In a related sense, the scope of policies and programs reflect the dominance of supply side measures and lack of demand side policy levers such as government procurement, regulations and standards policies. The lack of a sectoral emphasis on demand side measures is compensated for in the Turkish NIS through technology platforms to coordinate development among actors interested in or working on similar technologies. The insight policy document Vision 2023 was prepared in a similar collaborative fashion and was praised as it provided a selected set of industries to build on growth and development. However, most respondents in agencies and programs noted that the current structure of the decision making was not strong enough to change the existing horizontal R&D support scheme to more of a vertical one guided by the principles set by Vision 2023. Lack of restructuring of programs in congruence with various policy objectives and targets articulates that the state is still hesitant to adopt vertical support schemes based on selected industries.

The most common and troubling criticism of participants in NIS program implementation is the absence of any serious or systematic monitoring and evaluation of specific programs and projects. The literature and international agency best practice guidance emphasize that evaluation should be built into program design so that program goals are clear and match larger strategic goals of the national investment program. The link between the objectives of increasing national innovation and competitiveness and how well the NIS is addressing this objective is not evaluated in any systematic manner. Most informants emphasized the need for serious assessments and critical reports at the policy and plan making level with respect to how the current system is serving the stated objectives, how and in what ways the adopted NIS system promotes the development of comparative advantages, and what factors place Turkish industry on a competitive footing in international markets. However, as was emphasized in Chapter 5, the open and critical stance of agency and program leaders and the dearth of hollow promotional claims were very surprising and may bode well for the ongoing evolution and improvement of the NIS construction process.

8.1.3 What are the Unique Characteristics of Turkish Firms Engaged in Innovation Projects and How Important are Intra and Inter-Regional Collaborations in their Efforts?

All of the NIS institutions, policies, programs and support structures are directly or indirectly aimed at increasing the efficiency and effectiveness of business structure, the core of technology adoption and innovation development in the country. The set of firms in the interview sample were committed to innovative projects, and surprisingly active in patenting. In this sense government subsidy and support for innovation is registering some success in this set of firms and in terms of national science and technology outcome measures.

However, on the firm level, this dissertation research shows that innovative practices of firms are shaped by the level of industrial development, inexperience in developing and exploiting external relationships, and difficulty finding and cultivating markets for new more technically advanced products. Expanding existing customer base rather than innovating for new and or non-traditional markets was more important for most firms in the sample. This makes most of the firms actively engaged in innovation projects (and receiving government support) focus on technology and innovation activities for minor or major product improvements rather than developing major radical technologies. Their innovation strategy, knowledge acquisition and transfer, and technology development is very contingent upon endogenous resources. This does not mean that firms in the study sample innovate in isolation. The majority of sample firms had important external sources of knowledge and information, but they used more codified information resources such as the specialized literature, in-house R&D and the Internet. Most of the Turkish firms interviewed saw their competitive advantages as contingent upon their internal knowledge and skilled labor. Hence, most companies wanted to keep other firms and institutions at a distance to prevent knowledge and assets from leaking out. Their knowledge acquisition and R&D projects are highly contingent upon the quality of their customers and existing customer demands. Yet there is a significant subset of firms engaged in innovation to improve their performance on international markets by substantially upgrading their technologies and products or attempting to develop substantially new products for new markets. When the sample firms were categorized in four groups based on their technology capacity and product development strategies, firms that were more engaged in new, more technologically sophisticated product development viewed external relationships as more important.

One of the key research questions raised in the beginning was how present and strong are intra and inter-regional (including international) networks and relationships among innovative manufacturing firms in Ankara, Izmir and Istanbul? Among a variety of potential collaborators on innovation projects, customers together with suppliers, universities and consultants appear as important references and sources of information for firms in all three regions. External linkages with public institutions are growing and are becoming more important, but linkages with other private sector actors or institutions such as training centers, marketing companies, knowledge service providers, financial institutions etc., on the other hand are weak and not seen as important. Likewise there is very little evidence that deep regional associations have any kind of privileged status in the firm's innovation activities.

At the firm level, most of the survey/interview findings indicated that linkages and collaborations are at an early stage of development and exhibit certain problems and frictions. Customer and supplier linkages are more external to the firm's home region, and in many cases to the nation. Local links are important, especially new external relationships with consultants and universities. When we look at the collaboration patterns of case study firms, we see that Istanbul firms have more technical collaborations with their international customers and suppliers and they place the highest importance on their collaborations with international customers and suppliers. In terms of their collaborations with universities and consultants, Istanbul firms have more collaboration with regional universities and consultants. Yet they place the place the highest importance on their collaborations with national universities and international consultants. Izmir firms, similar to Istanbul firms, have more technical collaborations with their international customers and suppliers and they place the highest importance on these collaborations. Izmir firms have more collaboration with national universities and they place the highest importance on national universities. And Ankara firms, have more technical collaborations with their national customers and international suppliers and they place the highest importance on their collaborations with regional customers and international suppliers. Unlike the two other regions, regional customers receive high importance among Ankara firms due to the prominence of the defense industry in the region. Ankara firms, like Istanbul firms, have more collaboration with regional universities and consultants but they place the highest importance on their collaborations with national universities and international consultants. Firms' geographical distribution of technical collaborators shows that firms try to access to knowledge irrespective of their collaborators' proximity. In other words, innovative firms appreciate access to quality innovation collaborators regardless of regional proximity. If regions do not have sufficient resources or knowledge bases in the innovation process, firms, endowed with certain capabilities, often seek to co-operate with better endowed national and international actors.

8.1.4 How Important are Interactions and Collaborations at the Regional Level from the Perspective of Firms Engaged in Innovation Projects

The case study regions were used as units of analysis to understand the scope of interactions among innovation actors within the developing national innovation system in Turkey. The regional analysis intended to answer the key research question of how present and deeply embedded are components of regional innovation systems among innovative manufacturing firms in the main Turkish regions- Ankara, Izmir and Istanbul? In this respect, both the commonalities and the differences of the firms in different regions were sought to explain existing strengths and capacities at the regional level to the extent they inform the developing national innovation system policies.

All three study regions are large urban regions endowed with most of the specific institutions and actors alluded to in the RIS literature. Istanbul as the dominant primate city has a significantly higher degree of agglomeration advantages and institutional thickness than Izmir or Ankara. Specific local linkages and relationships were found to be important to the firms in the sample, but extra-regional relationships remain crucial to the innovation process. Durable and systemic collaborative practices among regional actors remain quite limited at this stage of technological development in Turkey. Innovative firms appreciate access to quality collaborators and reliable low cost suppliers regardless of regional proximity. Cooperation with customers, suppliers, universities and consultants stand out as important associations, while collaborations with public research institutes, industrial associations and marketing firms remain weak. Specific relationships with a variety of newly developing local institutions such as technology transfer organizations, business incubators, and labor training institutions remain underdeveloped. The firms interviewed did not typically assess their innovation processes as contingent upon systemic regional relationships or collaborations. Their innovation practices reflect higher national and international influences overriding the advantages rising from proximity to major local actors and institutions. The limited scope of collaboration partners (mainly customers, suppliers, consultants and universities) also suggest room for improvement in designing policies to increase interactions with institutions that specifically address gaps identified by these innovating firms (such as financial institutions, technical assistance providers etc.)

The findings in this dissertation strongly suggest a re-evaluation of the "spatial" dimension of RISs in more recently industrializing countries, especially since learning and innovation take place at all levels of production and geography (Malerba 2002). The regional patterns of co-operative relations found in the firm survey/interviews are interesting in their contrast with RIS and related literatures in the sense that firms rely on different actors and institutions based upon specific needs. If regions do not have sufficient resources or knowledge bases in the innovation process, firms, endowed with certain capabilities, often seek to co-operate with national and international actors. As shown in Ankara and Istanbul, even though these regions host the best universities in the country, firms search for their specific needs in other regions and consider these external links as critical in their innovation process. Likewise, firms in Izmir attach the highest value on the technical expertise they receive from other institutions to customers in Europe and Istanbul, highlighting the value of out-of-region resources for them.

So, regions are not characterized by a highly embedded set of institutions and at this stage of technology development - they remain dependent on strong links to the outside world. A better understanding of the role of proximity in the current context of technology development and innovation is essential given the recent emphasis on cluster-based innovation policies in Turkey. The key question is how to better calibrate the newly developing support institutions with the specific needs of regional firms. In certain instances the further development of local institutions and ties will be crucial to support the further evolution of the innovation process, but in other cases extra-regional ties should be encouraged.

8.1.5 Moving Forward: What are the Strengths and Weaknesses of the System and How Important are Regional Policies?

On balance, I would argue that the Turkish NIS construction process is a promising story, but a story with many complexities and potential pitfalls. Policies and institutions, filling virtually every area or element in common NIS model diagrams, have been developed in a relatively systematic manner. The fact that the development and implementation of the NIS elements has been associated with positive movements in key national science and technology indicators cannot be overlooked as a substantial achievement. There has been as significant turn toward technology based development over the past decade and Turkey's recent economic performance has been impressive, especially in the teeth of the current global economic slowdown.

Emphasizing the catch-up pressure put on the shoulders of the newly developing NIS, the central emphases that emerged out of the interviews with respect to the applicability of the NIS concept in Turkey are the challenges of fostering a cultural awareness of the importance of innovation, of building a systems perspective among program implementers and program clients and of meaningful information sharing and collaboration across bureaucratic boundaries. This research suggests at least that cultural awareness of the importance of technology advance and innovation is growing among public sector actors and private firms. The other important features of a successful NIS construction process are not clearly in place (for instance market creating regulations, government procurement, monitoring and evaluation etc.). There is a long way to go and more careful evaluation of efforts to foster collaboration between firms and external institutions is crucial at this stage. The institutions must move beyond just subsidizing firms to invest. They must be better engineered to link innovation to efforts to encourage external collaboration and to build thicker innovation networks. The NIS construction process moving forward must pay attention to how to build on and diversify existing linkages supporting technological change and innovation.

Based on what was found in this investigation, should regions have a more prominent place in future policy making related to the NIS? and How can national innovation policy take better advantage of existing strengths and capacities at the regional level?

The historical evolution of science, technology and innovation policies indicates that the central government agencies leading the NIS construction effort have never had an intentional approach the technology development problem at the local scale in Turkey. One important reason for that is the lack of autonomous regional governments endowed with power to make decisions to influence the productive and innovative structures of localities. Very recently, as part of the European Union integration project and also as part of the policy discussions around developing the NIS, regions started to emerge as a new scale for innovation policies. The common arguments related to benefits from the external economies or collective efficiencies associated with proximity and learning is being taken more seriously. Unfortunately, as articulated by some interviewees, clusters and RISs became buzzwords for many localities and even in some cases proposed to be established from scratch according to major typologies that exist in other country examples.

In respect to this contemporary discussion, this research presents important findings by articulating existing collaborative strengths and weaknesses according to major innovation partners in different localities. For instance, collaborations of firms in Izmir show that innovative firms widely interact with high quality research universities in other parts of the country and value their contributions more than local universities for the success of their firms. In such a case endorsing an endogenous growth strategy within the study regions by improving regional innovation support systems (Hassink 2002) and also absorptive capacities (Asheim and Vang 2005) is not enough in itself since most innovative firms have stronger linkages with external partners, such as universities and consultants at different geographies. On the other hand, firms in Izmir also highly value their collaborations with customers and suppliers in other countries. The exogenous growth model (Asheim and Vang 2005) which highlights the importance of external knowledge sources and the necessity to connect with larger more advanced firms in global production networks due to limited local capacities and institutions in developing countries might be more relevant to actual technology adoption and innovation efforts of some firms than trying to force regional linkage. The limited variety of innovation collaborators in Izmir as in the other regions would seem to benefit most from Feser's (2005,2008) synergy leveraging approach.

This research broadly supports the notion of building upon existing institutions, linkages and interactions rather than on establishing abstract models of local or non-local clusters. The scope and geographies of collaborations may contribute national policies best through appropriate and flexible measures that cultivate collaborative and productive structures at the regional scale when an advantage is clearly demonstrated. The central state should continue to invest on absorptive capacities of regions but instead of adopting abstract models, firms should be given specific consideration within their greater sectoral and industrial context and the means that encourage their participation in national and global production networks should be incorporated into the system. In this context, leveraging synergies between innovative actors and knowledge providers, irrespective of space, might serve better for the fuller development of the firms and also the developing national innovation system. It is hoped that this dissertation makes some important strides in this direction.

Appendix A: Questionnaire

Name of Enterprise: ---
Location of Enterprise: ---
Name of Respondent: --
Position: ---
Telephone: ---
E-mail: ---
Survey #: --

Part 1: Firm Characteristics, Innovation and Competitiveness

1. Please give a brief description of the products designed and manufactured in your firm?

____

____

2. In what year was your firm initially set up? ______________

3. How long have you been located in this region? ______________
   a. Has your firm ever been relocated? ☐ Yes ☐ No
   b. If yes, where: ☐ Another region ☐ Same region another location

4. What is the organizational status/ ownership structure of your firm?
   - ☐ Independent firm
   - ☐ Family firm
   - ☐ Branch plant of a Turkish firm
   - ☐ Branch plant of a foreign firm
   - ☐ Head office of a Turkish firm
   - ☐ Turkish head office of a foreign firm
   - ☐ Joint venture

5. What was the status of your firm at establishment?
   - ☐ New independent start-up
   - ☐ Family firm
   - ☐ Spin-off from another firm
   - ☐ Subsidiary of another firm
   - ☐ Branch plant
   - ☐ Other ________________

6. How did your activity evolve since the firm founded?
   - ☐ Same basic knowledge, incremental change
   - ☐ Radical change compared to past
   - ☐ No change, too early in firm history
   - ☐ Changed product/market segment
   - ☐ Process technology totally different from past

7. Does your establishment produce:
   - ☐ A final product
   - ☐ An intermediate product
   - ☐ A service

8. Which of the following types of activities are located at your firm in this location?

☐ Manufacturing

☐ R&D

☐ Management

☐ Sales

☐ Marketing

☐ Other __________

9. What is the employment of your firm?

☐ 1-25 ☐ 26-50 ☐ 51-99 ☐ 100-249 ☐ 250 +

10. How does this compare with the number of employees three years ago?

☐ Increased ☐ Decreased ☐ Stayed same

11. Please indicate the total value of gross revenues generated by your firm at this address.

____

12. How are your revenues distributed **(by percentage)** among the following regions?

☐ Ankara __________________

☐ Izmir __________________

☐ Istanbul __________________

☐ Elsewhere in Turkey __________________

☐ Europe __________________

☐ United States __________________

☐ Elsewhere in the world __________________

11. During the last 3 years, has your firm introduced any technologically new or improved product into the market?

☐ Yes

☐ No

a. If yes, how many? ___________________

13. Was the most important technologically new or improved product:

☐ A world first ☐ A first in Turkey ☐ A first for your firm

14. Did your company undertake any of the following activities during the last five years?

	Yes	No
Developed or modified an existing process	☐	☐
Introduced changes in management routines	☐	☐
Introduced a new marketing technique	☐	☐
Introduced an internal training program	☐	☐
Introduced an external training program	☐	☐
Developed a new market in Turkey	☐	☐
Developed a new market abroad	☐	☐
Reverse engineered any product or process	☐	☐

15. Please indicate the importance of following reasons for conducting innovative activities? Why does your firm innovate?

Reasons for Innovating	Very Important	Moderately Important	Slightly Important	Not Important
Decrease production costs	☐	☐	☐	☐
Decrease processes costs	☐	☐	☐	☐
Extend product range	☐	☐	☐	☐
Increase product quality	☐	☐	☐	☐
Comply with the demands of customers	☐	☐	☐	☐
Deal with new competitors at home	☐	☐	☐	☐

Deal with new competitors in export markets	☐	☐	☐	☐
Achieve market leadership	☐	☐	☐	☐
Comply with local laws or standards	☐	☐	☐	☐
Develop more environmental friendly products or processes	☐	☐	☐	☐
Availability of government support	☐	☐	☐	☐

16. Please indicate the importance of following sources of information for your innovation?

Knowledge Sources	Used	Not Used	Very Important	Moderately Important	Slightly Important	Not Important
Market (new products, etc)	☐	☐	☐	☐	☐	☐
Within your firm internal R&D department	☐	☐	☐	☐	☐	☐
Within your firm production line	☐	☐	☐	☐	☐	☐
Parent firm	☐	☐	☐	☐	☐	☐
Customers/Client firms	☐	☐	☐	☐	☐	☐
Competitors	☐	☐	☐	☐	☐	☐
Partners	☐	☐	☐	☐	☐	☐
Associated companies within your corporate group	☐	☐	☐	☐	☐	☐
Suppliers of equipment or material	☐	☐	☐	☐	☐	☐
Consultancy firms or consultants in person	☐	☐	☐	☐	☐	☐
Marketing firms	☐	☐	☐	☐	☐	☐
Fairs and exhibitions	☐	☐	☐	☐	☐	☐
Industry associations	☐	☐	☐	☐	☐	☐
Chamber of Commerce	☐	☐	☐	☐	☐	☐
Chamber of Industry	☐	☐	☐	☐	☐	☐
Technical Schools	☐	☐	☐	☐	☐	☐
Universities	☐	☐	☐	☐	☐	☐
Public Research Institutes	☐	☐	☐	☐	☐	☐
Private Research Institutes	☐	☐	☐	☐	☐	☐
Venture Capital Organizations	☐	☐	☐	☐	☐	☐
Innovation Relay Centers	☐	☐	☐	☐	☐	☐

Government Programs (TUBITAK, TTGV, KOSGEB)	☐	☐	☐	☐	☐	☐
Specialized literature	☐	☐	☐	☐	☐	☐
Internet	☐	☐	☐	☐	☐	☐

17. How do you plan to increase access to new sources of information/knowledge?

☐ Cultivate linkages with other actors
☐ Train employees internally
☐ Participate in exhibitions
☐ Other _____________
☐ Train employees externally
☐ Hire new specialists
☐ Have not thought about it

18. Please rate the importance of each of the following competences to your firm during the last five years?

a. Organizational Competences

Organizational Competences	NA	Very Important	Moderately Important	Slightly Important	Not
Structuring of the company around innovative projects	☐	☐	☐	☐	☐
Encouraging joint work to innovate	☐	☐	☐	☐	☐
Incentives to formulate new ideas	☐	☐	☐	☐	☐
Rewarding the ideas that have been selected	☐	☐	☐	☐	☐
Pooling of knowledge	☐	☐	☐	☐	☐
Identification of the knowledge and strategic know-how	☐	☐	☐	☐	☐
Identification of the people holding strategic know-how	☐	☐	☐	☐	☐
Making everybody aware of the need for adapted training	☐	☐	☐	☐	☐
Evaluation of the impact of training on the innovation process	☐	☐	☐	☐	☐
Reward for useful training	☐	☐	☐	☐	☐

b. Technical Competences

Technical Competences	NA	Very Important	Moderately Important	Slightly Important	Not
Effectiveness and the quality control of the production	☐	☐	☐	☐	☐
Technological evaluation of the products which the company is likely to produce	☐	☐	☐	☐	☐
Technological evaluation of the processes which the company is likely to adopt	☐	☐	☐	☐	☐
Carrying out a technological assessment of the company	☐	☐	☐	☐	☐

c. Competences in Collaborating with Customers

Competences in collaborating with customers	NA	Very Important	Moderately Important	Slightly Important	Not
Analyzing the nature and the needs of the customers	☐	☐	☐	☐	☐
Collecting customers reactions at after-sales services or retailers	☐	☐	☐	☐	☐
Using the product as a source of information about the customers satisfaction	☐	☐	☐	☐	☐
Special offers for new products	☐	☐	☐	☐	☐
Determination of the target, the media and the type of message for advertising new products	☐	☐	☐	☐	☐
Company’s innovation image	☐	☐	☐	☐	☐

d. Competences in Finance

Competences in finance	NA	Very Important	Moderately Important	Slightly Important	Not Important
Anticipation of the whole set of the costs of innovation	☐	☐	☐	☐	☐
Knowing the private and public modes of innovation	☐	☐	☐	☐	☐
Communication strategy towards potential financial partners of innovation	☐	☐	☐	☐	☐

e. Competences in Relations with Competitors

Competences in relations with competitors	NA	Very Important	Moderately Important	Slightly Important	Not Important
Analyzing competing products	☐	☐	☐	☐	☐
Analyzing patents of the competitors	☐	☐	☐	☐	☐
Knowing competitors technologies	☐	☐	☐	☐	☐
R&D alliances with other companies	☐	☐	☐	☐	☐
Using external inventions (patents, licences)	☐	☐	☐	☐	☐
Joint ventures, various strategic alliances and forms of cooperation	☐	☐	☐	☐	☐

f. Competences in Interacting with Suppliers

Competences in interacting with suppliers	NA	Very Important	Moderately Important	Slightly Important	Not Important
Fast adoption of the technologically new equipment	☐	☐	☐	☐	☐
Fast adoption of the technologically new supplies	☐	☐	☐	☐	☐
Subcontracting or acquisition of R&D	☐	☐	☐	☐	☐
Absorption capacities of the knowledge incorporated in the innovating equipment and components	☐	☐	☐	☐	☐

19. Does your firm conduct on site R&D activities?

☐ Yes ☐ No

a. If yes, which of the following R&D activities have been carried out in your firm during the last 3 years?

☐ Basic Research ☐ Applied Research ☐ Experimental Development

- ☐ Processes
- ☐ Product Design
- ☐ Prototyping
- ☐ Product Testing

20. What was the annual average expenditure of your firm on R&D activities during the last 5 years? _________________

21. What was the total number of people working in R&D in your firm?

☐ Part time _______ ☐ Full time ________

22. Have any patents been applied for in your firm during the last five years?

☐ Yes ☐ No

a. If yes, how many? __________

23. Have any patents been granted to your firm during the last five years?

☐ Yes ☐ No

a. If yes, how many patents have been awarded and where?

__________ __________

24. Please rate the importance of each of the following obstacles and/or hindrances to your firm in innovation activities during the last three years?

Obstacles/Hindrances	Very Significant	Moderately Significant	Slightly Significant	Not Significant
High cost of developing new products and processes	☐	☐	☐	☐
Lack of financing, risk and investment capital	☐	☐	☐	☐
Lack of qualified or skilled personnel	☐	☐	☐	☐
Long administrative/approval procedures	☐	☐	☐	☐
Lack of strong customer demand	☐	☐	☐	☐
Lack of marketing capability	☐	☐	☐	☐
Unfavorable domestic macroeconomic conditions (recession, inflation, etc)	☐	☐	☐	☐
Ineffectiveness of legal conditions supporting innovation (for instance intellectual property rights)	☐	☐	☐	☐
Lack of networking with other firms and institutions	☐	☐	☐	☐
Lack of information on technology	☐	☐	☐	☐
Lack of external technical and consultant support services	☐	☐	☐	☐
Lack of access to expertise in universities and higher education institutes	☐	☐	☐	☐
Lack of access to expertise in research institutions	☐	☐	☐	☐
Lack of information on research and technical programmes	☐	☐	☐	☐
Lack of information on government support programmes	☐	☐	☐	☐

25. Please indicate the importance of following government support programs for innovative activities in your firm.

Government Support Programs	Very Important	Moderately Important	Slightly Important	Not Important
R&D funding	☐	☐	☐	☐
Training	☐	☐	☐	☐
Subsidies	☐	☐	☐	☐
Tax rebates	☐	☐	☐	☐
Technical Support/Advice	☐	☐	☐	☐
Infrastructure Support	☐	☐	☐	☐
Loans and grants	☐	☐	☐	☐
Other	☐	☐	☐	☐

Part 2: External Knowledge Resources and Regional Embeddedness of Firms in Innovation Processes

26. The variables presented below are key dimensions regarding the general character of innovation by firms, regions and nations. They assist the placing of regional and national firm innovation in relation to lower (left-side: 1-2) or higher (right-side 3-4) degrees of systemic regional and national innovation. Please place your firm in one of the four categories considering that the first table indicates regional and second table indicates national innovation systems.
    Scale: 1: High, 2: Fairly High, 3: Fairly Low, 4: Low

		1	**2**	**3**	**4**	
Source of innovation	Globalised	☐	☐	☐	☐	Regionalized
Implementation of innovation	Individualistic	☐	☐	☐	☐	Interactive
Inter-firm relations	Competitive	☐	☐	☐	☐	Co-operative
Customer-supplier relations	Market	☐	☐	☐	☐	Preferred supplier
Supply-chain	Fragmented	☐	☐	☐	☐	Integrated
Support infrastructure	Isolated	☐	☐	☐	☐	Networked

		1	2	3	4	
Source of innovation	Globalised	☐	☐	☐	☐	Nationalized
Implementation of innovation	Individualistic	☐	☐	☐	☐	Interactive
Inter-firm relations	Competitive	☐	☐	☐	☐	Co-operative
Customer-supplier relations	Market	☐	☐	☐	☐	Preferred supplier
Supply-chain	Fragmented	☐	☐	☐	☐	Integrated
Support infrastructure	Isolated	☐	☐	☐	☐	Networked

27. Please indicate the organizations and their importance in providing technical expertise to your firm during the last five years.

Innovation Partners	Regions						
	Ankara	Izmir	Istanbul	Elsewhere in Turkey	Europe	USA	Elsewhere in World
Other units within the firm	☐	☐	☐	☐	☐	☐	☐
Parent firm	☐	☐	☐	☐	☐	☐	☐
Customers/Client firms	☐	☐	☐	☐	☐	☐	☐
Competitors	☐	☐	☐	☐	☐	☐	☐
Partners	☐	☐	☐	☐	☐	☐	☐
Associated companies within your corporate group	☐	☐	☐	☐	☐	☐	☐
Suppliers and sub-contractors	☐	☐	☐	☐	☐	☐	☐
Consultancy firms or consultants in person	☐	☐	☐	☐	☐	☐	☐
Marketing firms	☐	☐	☐	☐	☐	☐	☐
Industry associations	☐	☐	☐	☐	☐	☐	☐
Chamber of Commerce	☐	☐	☐	☐	☐	☐	☐
Chamber of Industry	☐	☐	☐	☐	☐	☐	☐
Technical Schools	☐	☐	☐	☐	☐	☐	☐
Universities	☐	☐	☐	☐	☐	☐	☐
Public Research Institutes	☐	☐	☐	☐	☐	☐	☐
Public Research Institutes	☐	☐	☐	☐	☐	☐	☐

Venture Capital Organizations	☐	☐	☐	☐	☐	☐	☐
Innovation Relay Centers	☐	☐	☐	☐	☐	☐	☐
Science and Technology Parks							
Government Programs (TUBITAK, TTGV*, KOSGEB)	☐	☐	☐	☐	☐	☐	☐

1: Very Important, 2: Moderately Important, 3: Slightly Important, 4: Not Important

28. Please indicate the motives for your firm for exercising collaborative activities
1: Very Important, 2: Moderately Important, 3: Slightly Important, 4: Not Important

	Collaborative Activities With				
Motives	Universities	Research Institutions	Consultants	Other Manufacturing Firms	Business/Industry Associations
Idea Generation/Improvement	☐	☐	☐	☐	☐
Risk/Cost Reduction	☐	☐	☐	☐	☐
New Technological Opportunities	☐	☐	☐	☐	☐
Know-How Takeover	☐	☐	☐	☐	☐
Financial Resources	☐	☐	☐	☐	☐
Funding Requirements	☐	☐	☐	☐	☐
Marketing Purposes	☐	☐	☐	☐	☐
Training Purposes	☐	☐	☐	☐	☐
Testing/Quality Control	☐	☐	☐	☐	☐

29. Please indicate the types of collaborations with other firms and their importance for your firm during the last five years.

1: Very Important, 2: Moderately Important, 3: Slightly Important, 4: Not Important

Types Of Collaborations	Regions						
	Ankara	Izmir	Istanbul	Elsewhere in Turkey	Europe	USA	Elsewhere in World
Formal Collaborations (strategic alliances, joint production, product or process development)	☐	☐	☐	☐	☐	☐	☐
Informal Collaborations	☐	☐	☐	☐	☐	☐	☐
Stable sub-contracting/supplier relationship	☐	☐	☐	☐	☐	☐	☐

30. Please indicate the types of collaborations with the following organizations and their importance for your firm during the last five years.

Types Of Collaborations	Universities						
	Ankara	Izmir	Istanbul	Elsewhere in Turkey	Europe	USA	Elsewhere in World
Informal Contact	☐	☐	☐	☐	☐	☐	☐
Research Contract	☐	☐	☐	☐	☐	☐	☐
Joint Research	☐	☐	☐	☐	☐	☐	☐
Consulting/reports	☐	☐	☐	☐	☐	☐	☐
Training of personnel	☐	☐	☐	☐	☐	☐	☐

Tests/Control	☐	☐	☐	☐	☐	☐	☐

1: Very Important, 2: Moderately Important, 3: Slightly Important, 4: Not Important

Types Of Collaborations	Research Institutions						
	Ankara	Izmir	Istanbul	Elsewhere in Turkey	Europe	USA	Elsewhere in World
Informal Contact	☐	☐	☐	☐	☐	☐	☐
Research Contract	☐	☐	☐	☐	☐	☐	☐
Joint Research	☐	☐	☐	☐	☐	☐	☐
Consulting/reports	☐	☐	☐	☐	☐	☐	☐
Training of personnel	☐	☐	☐	☐	☐	☐	☐
Tests/Control	☐	☐	☐	☐	☐	☐	☐

Types Of Collaborations	Other Institutions						
	Ankara	Izmir	Istanbul	Elsewhere in Turkey	Europe	USA	Elsewhere in World
Informal Contact	☐	☐	☐	☐	☐	☐	☐
Research Contract	☐	☐	☐	☐	☐	☐	☐
Joint Research	☐	☐	☐	☐	☐	☐	☐
Consulting/reports	☐	☐	☐	☐	☐	☐	☐
Training of personnel	☐	☐	☐	☐	☐	☐	☐
Tests/Control	☐	☐	☐	☐	☐	☐	☐

31. Please indicate the problems with exercising collaborative activities.

	Collaborative Activities With				
Problems	Universities	Research Institutions	Consultants	Other Manufacturing Firms	Business/Industry Associations
Problems with Project Management	☐	☐	☐	☐	☐
Budgeted Cost Overrun	☐	☐	☐	☐	☐
Unintended Knowledge Drain	☐	☐	☐	☐	☐
Coordination Difficulties	☐	☐	☐	☐	☐
Different Capabilities	☐	☐	☐	☐	☐
Confidential Relation/Secrecy	☐	☐	☐	☐	☐
Loss of Independence	☐	☐	☐	☐	☐
Lack of Schedule Effectiveness	☐	☐	☐	☐	☐

32. Please indicate the importance of proximity to other institutions in YOUR REGION.

	Very Important	Moderately Important	Slightly Important	Not Important
Suppliers and subcontractors	☐	☐	☐	☐
Consultants	☐	☐	☐	☐
Customers	☐	☐	☐	☐
R&D collaborators (universities, research institutions, consultants, etc.)	☐	☐	☐	☐
Competitors	☐	☐	☐	☐
Institutions providing services	☐	☐	☐	☐
Banking/venture capital services	☐	☐	☐	☐
Other	☐	☐	☐	☐

33. Please rate the importance of following regional factors for the success of your firm.

	Very Important	Moderately Important	Slightly Important	Not Important
Local/regional entrepreneurial culture	☐	☐	☐	☐
Trust between actors	☐	☐	☐	☐
Scientific and technical culture in the region	☐	☐	☐	☐
Degree of industrial specialization in the region	☐	☐	☐	☐
Diversification of economic activities	☐	☐	☐	☐
Accessibility to markets	☐	☐	☐	☐
Availability of skill labor	☐	☐	☐	☐
Availability of local labor	☐	☐	☐	☐
Quality of labor education	☐	☐	☐	☐
Proximity to universities	☐	☐	☐	☐
Quality of physical infrastructure	☐	☐	☐	☐
Quality of communications networks	☐	☐	☐	☐
Cultural amenities	☐	☐	☐	☐

34. Please indicate the principle obstacles constraining the innovative activities of your firm?

Thank you for your time and cooperation!

*** In the final survey design, the studies of Cooke 2002, Doloreux 2002, UNU-INTECH 2004, Ronde and Hussler 2005 were extensively used to extract the knowledge required to answer the main research questions.

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