DYNAMICS OF HIGH-TECH INDUSTRIAL DISTRICTS AND SOME IMPLICATIONS FOR TURKEY

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ABSTRACT

DYNAMICS OF HIGH-TECH INDUSTRIAL DISTRICTS AND SOME IMPLICATIONS FOR TURKEY

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Aim of this study is to clarify the dynamics of high-tech industrial districts in order to shed some light on the possibility of replication of them in Turkey. If the regions and cities are to be an integrated part of the new global socio-spatial regulation, they should develop their own innovation capacity through establishing viable high-tech industrial districts. How and why do high-tech industries develop in a specific location and not in others? What is special in terms of social, economic and especially local characteristics and processes to this type of industrial development? And why is it so? This thesis essentially tries to answer these questions.

For this purpose, firstly, a theoretical framework relating to the high-tech industrial districts have been constructed. Secondly, in order to highlight the dynamics of high-tech industrial districts, structural characteristics of and regulation mechanisms relating to this kind of industrial districts have been analyzed by reviewing a wide range of high-tech regions and centers spread all around the world. Thirdly, Turkish high-tech industrial development

experience have been investigated and characteristics of potential technology development centers have been analyzed as case studies in order to bring about some implications and policy prescriptions for their transformation into viable high-tech regions. Lastly, making a general evaluation some policy implications specific to Turkey have been drawn.

The methodology of the study is a kind of literature survey and comparative analysis with reference to the available written documents on the topic, statistical values, field surveys, historical data and various publications.

Keywords: Industrial districts, innovative milieux and networks, learning region, techno- and science parks, technology development centers, models of innovation, trust and synergy, tacit knowledge, production networks and organization, high-tech regulation mechanisms.

ÖZ

YÜKSEK TEKNOLOJİ SANAYİ BÖLGECİKLERİNİN DİNAMİKLERİ VE TÜRKİYE İÇİN BAZI ÇIKARSAMALAR

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Bu çalışmanın amacı yüksek teknoloji sanayi bölgeciklerinin dinamiklerini aydınlatarak bu tür bölgeciklerin Türkiye'de tekrarlanabilmesi olasılığına ışık tutmaktır. Eğer bölgeler ve kentler yeni küresel sosyo-mekansal düzenlemenin bir parçası olmak istiyorlarsa, yaşayabilir yüksek teknoloji sanayi bölgecikleri kurarak kendi buluşçu kapasitelerini geliştirmeleri gerekir. Yüksek teknoloji sanayileri neden ve nasıl belli bölgelerde gelişmekte ve diğerlerinde gelişememektedir? Sosyal, ekonomik ve özellikle yerel özellikler ve süreçler bakımından bu tür sanayi gelişimine özel olan hususlar nelerdir? ve bu neden böyle olmaktadır? Bu tez temelde bu soruları cevaplamaya çalışmaktadır.

Bunun için, bu çalışmada; ilk olarak, yüksek teknoloji sanayi gelişimine ilişkin kuramsal bir altlık oluşturulmakta; daha sonra, yüksek teknoloji sanayi bölgeciklerinin dinamiklerinin aydınlatılabilmesi için tüm dünyaya yayılmış bulunan yüksek teknoloji bölgelerinin ve merkezlerinin bir çoğu gözden geçirilerek bu tür bölgeciklerin yapısal özellikleri ve düzenleme mekanizmaları çözümlenmekte; bunu takiben, Türkiye'deki yüksek teknoloji

bölgelerinin gelişimi araştırılmakta ve teknoloji geliştirme merkezlerinin yaşayabilir yüksek teknoloji bölgelerine dönüştürülmesi için bazı çıkarsamaların ve politika reçetelerin belirlenmesi bakımından potansiyel teknoloji geliştirme merkezleri örnek çalışmalar olarak ele alınarak özellikleri çözümlenmekte; ve son olarak ta, genel bir değerlendirme ve durum tespiti yapılarak, Türkiye'ye özgü bazı çıkarsamalar elde edilmektedir.

Çalışmanın yöntemi bir tür yazın taraması ve konu üzerine elde edilebilen yazılı dokümanlar, istatistiksel değerler, alan çalışmaları, tarihsel veriler ve değişik yayınlara gönderme ile yapılan karşılaştırmalı çözümlemelerdir.

Anahtar Kelimeler: Sanayi bölgecikleri, buluşçu çevreler ve ağlar, öğrenen bölge, teknoparklar ve bilim parkları, teknoloji geliştirme merkezleri, buluş modelleri, güven ve sinerci, kapalı ifade olunan bilgi, üretim ağları ve örgütlenmeleri, yüksek teknoloji düzenleme mekanizmaları.

To My Beloved Father

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LIST OF ABBREVIATIONS

AFZ	: Aegean Free Zone
ASELSAN	: Askeri Savunma ve Elektronik Sanayi
ATRP	: Anadolu Technology Research Park
AU	: Ankara University
BC-NET	: Business Cooperation Network
BRE	: Bureau de Rapprochment des Enterprrises
BU	: Boğaziçi University
CAD	: Computer Aided Drawing
CAM	: Computer Aided Management
DPT	: Devlet Planlama Teşkilatı
EICC	: Euro Info Correspondence Center
EICN	: European Info Centre Network
ESBAŞ	: Ege Serbest Bölgesi Kurucusu ve İşleticisi Anonim Şirketi
EU	: European Union
FZ	: Free Zone
GATT	: General Arrangement on Tariffs and Trade
GDE	: General Directorate of Exports
GDFI	: General Directorate of Foreign Investments
GDFZ	: General Directorate of Free Zones
GDIDE	: General Directorate of Industrial Districts and Estates
GDII	: General Directorate of Incentive Implication
GNP	: Gross National Product

GOIZ : Gebze Organised Industrial Zone

HCST : Higher Council of Science and Technology

HTIPİPK : High-tech Industrial Park of İstanbul-Pendik-Kurtköy

IC : Integrated Circuits

IEF : Investment Encouragement Fund

IHTI : İzmir High-Technology Institute

ITERI : Information Technologies and Electronics Research Institute

İTI : İzmir Technopark Inc.

İTU : İstanbul Technical University

JIT : Just-in-time

KOSGEB : Küçük ve Orta Ölçekli Sanayiyi Geliştirme ve Destekleme İdaresi Başkanlığı

KTU : Karadeniz Technical University

METU-Tech : Middle East Technical University Technopolis

METU : Middle East Technical University

MRCT : Marmara Research Center Technopark

NIC : Newly Industrialized Countries

OIZ : Organized Industrial Zone

RAM : Random Access Memory

SED : Small Enterprise Development Centre

SHFZP : Software Houses Free Zone Project

SIE : Small Industrial Estates

SME : Small and Medium Sized Enterprise

SMHTF : Small and Medium Sized High-Tech Firm

SMIDO : Small and Medium Sized Industry Development Organization

SPO : State Planning Organization

TÜBİTAK : Türkiye Bilimsel ve Teknik Araştırma Kurumu

TDC : Technology Development Center

TDFT : Technology Development Foundation of Turkey

TDTCAFZ : Technology Development-Transfer Center of Aegean Free Zone

TDZ : Technology Development Zone

TEITI : Turkish Electronics Industry and Trade Inc.

TNC : Trans National Cooperations

TOEO : Technology Observation and Evaluation Organization

TQM :Total Quality Management

TSTRC : Turkish Scientific and Technical Research Council

UNFSTD : United Nations Fund of Supporting Technological Development

UNIDO : United Nations Industrial Development Organization

VAT : Value Added Tax

WTO : World Trade Organization

YTU : Yıldız Technical University

CHAPTER 1

INTRODUCTION

The emerging functional and structural transformations due to the globalization processes after the II. World War gave rise to the emergence of a new global regulation. Before the war, the 1930s crisis paved the way for greater involvement of the state in economic relations on a macro scale. As monopoly conditions in the productive sphere that is characterized by Fordist mode of production allowed firms to maintain prices irrespective of demand, nation-states became interventionist through social programs in order to maintain the levels of total consumption. For this purpose the well being of people had been increased as much as possible. This is realized throughout the redistribution mechanism of welfare state and macroeconomic steering mechanisms of Keynesian economic policy. The equal distribution of income had guaranteed the continuos demand for the mass production by increasing purchasing power of individuals. In this way, development and diffusion of Fordist mass production was supported by well-fare state policies. In other words, Fordist production necessitated the dominance of a powerful regulation system over national boundaries and the basic requirements from this regulation mechanism was the creation of the consumption capacity needed to maintain the mass production[1]. But the internal dynamics of Fordism gave rise to the evolution of a different mode of production; flexible production.

Fordist mode of production is based on assembly lines through which each worker specialize in doing a certain part of the production as it comprise the deskilling of labor by means of the fragmentation of work tasks. However, the fact that absence of any worker within the assembly line interrupts the production has increased the negotiation power of workers with employers and they begun to demand higher wages by establishing labor unions. Parallel to this, what is emerging all over the world was the ubiquitification of previously important locational factors due to the improvements in transportation and communication technology (being near to large markets have decreased in importance). Thus, as the local labor practices

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of the period were rigid and the trade unions sufficiently powerful to prevent significant restructuring, the initial response to the increasing power of local labor was the relocation of plants to periphery where labor was cheaper. Subsequently, traditional collectivist pay bargaining structures have been diffused and increased use of subcontracting arrangements has been realized. In addition to these, robots have been increasingly used in industrial production. These developments have resulted in an increasingly segmented labor force and the power of labor to resist capital has been further weakened.

The internationalization of production and the growth of the export sector meant that wages were increasingly seen as a drag on economic competitiveness rather than a contributor to consumption (Tickell and Peck, 1992: 195). Consequently, real wages began to slow down and then decline, compounding the problems of stagnating consumer demand. Keynesian demand management faltered, becoming discredited as a macroeconomic philosophy (Tickell and Peck, 1992: 195). By the late 1970s, the whole regime of Fordist accumulation together with its Keynesian welfare-statist mode of social regulation was beginning to unwind in significant ways (Scott, 1988: 174). This unwinding was manifest in the rise of Thatcherism in the UK and Reaganism in the US (Scott, 1988, 174). The virtuous cycle of Fordism had turned vicious. The obsolescence of redistribution mechanisms of welfare state necessitated new solutions to overcome the crisis. After the 1973 crisis, it was understood that small firms are more resistant to crisis because of their inherent flexibility. The new strategy was to make individuals more active and give them an entrepreneurial spirit. Instead of increasing production by supporting consumption through redistribution mechanisms, the ways of making people more productive was searched. Small and medium sized entrepreneurs were supported to solve the unemployment problem. Deregulation has become the main policy of 1970s and 1980s.

The combined effect of a globalized and de-regulated world economy, dominated by TNCs (Trans National Cooperations), and the reduced power of nation-states due to a transfer of authority to supranational organizations created a shift in the regime of international trade relations from comparative advantage on the basis of relative best access to, and most efficient use of, 'natural' production factors to socially produced competitive advantage. On the sub-national, regional level this will lead to a polarized development of increased differentiation in innovation and economic growth between successful and unsuccessful regions, thus making the innovative capacity of firms and regions of strategic importance in determining regional futures.

In order to change these development tendencies and to promote a process of job-generating growth an important question is whether regions, as a result of post-Fordist changes in the organization and location of production, can develop a new competitive advantage derived from territorially agglomerated SMEs (Small and Medium Sized Entrepreneurs). This question is of strategic importance academically as well as politically in the perspective of the globalization-localization debate, as a positive answer would provide a solid basis for launching a policy for endogenous industrial and regional development. New strategy is to turn localities into self-promoting islands of entrepreneurship with the help of industrial districts, however, this strategy faces some major difficulties if it is to become a universally viable strategy for local economic regeneration.

In general, industrial district experience of the world can be classified into two different categories. The first one covers those where local firms fail to develop into viable industrial districts. They are rather characterized by 'global Fordism' and labeled as industrial agglomerations (Humprey, 1995: 156) or 'satellite industrial platforms' (Park and Markusen, 1995: 82, and Wang and Wang, 1998: 682), where firms operate with mass production processes and little local R&D. Global Fordism is rather characterized by lean production fundamentals of which are universal and applicable to anywhere. Lean production is different from mass production wholesale in spite of their basic resemblance.[2] TNCs operating on the base of lean production have worldwide branch plants especially in low wage regions. Hence, this type of industrial agglomerations is generally observed in less developed regions and in NICs (Newly Industrialized Countries). The findings in those regions show a coexistence of small-firm based flexible specialization and Fordist mode of production having in-firm flexibility realized throughout the JIT (Just-in-time) and TQM (Total Quality Management) techniques.

The second one is well-known industrial district model that reflects a return to place and is characterized by flexible specialization and technologically dynamic regional economies in which networks of specialist producers both compete and cooperate in response to fast-changing global markets. In these districts, technical skill and competence are widely diffused, small and medium sized firms achieve external economies through complex supplier and subcontracting relations, and the region not the firm is the locus of production. The result is a decentralized system that is more flexible than the traditional vertically integrated corporation. Industrial district model also has two general variants; the northern Italian model and high-tech industrial districts. The latter constitutes the subject of the thesis.

Theoretical discussion which revolves around the genesis and growth of high-tech industrial regions can be grouped into five general different categories; long wave theory, product life-cycle theory and product profit-cycle theory, locational determinant theory, theory of flexible specialization and production (industrial district paradigm), innovative milieux and network approaches together with regional collective learning and learning region approaches. These theoretical discourses historically and contextually overlap with each other. Especially the last two groups of theories of high-tech industrial development constitute the material evidence of high-tech industrial regions. High-tech industrial district paradigm which is based on the theory of flexible production - specialization and innovative milieux - network approaches together with regional collective learning - learning region approaches makes use of some of the explanations of long wave theory, product cycle theories and locational determinant theory together with some of the regional disequilibrium theories such as Perroux's growth pole theory.

'Long wave'[3] theoreticians claiming that history of capitalism is marked by long waves of a series of great inventions lasting typically from 45 to 60 years place the emphasis on the importance of innovation in capitalist development as the source of regeneration and cast the entrepreneur in a key role as the innovator who is responsible for Schumpeter's 'creative destruction' (Simmie, 1998: 1263; Thompson, 1989: 127-8; Sternberg, 1996: 522; Florida and Kenney, 1988: 44; Castells and Hall, 1994: 234-235; Malecki, 1991: 171-173 and Hall, 1985: 7). Opponents of the theory on Marxist perspective claims that individual entrepreneurs and tangible technologies are the wrong focus, and that what the empirically observable cycles are really reflecting is fluctuations in capital accumulation (Mandel, 1983; Thompson, 1989: 130 and Hall, 1985: 9). Mandel (1983: 195) argues that although basic innovations are bunched in a 'countercyclical' manner during the depressive phases of long waves, they do not themselves cause the transition to an expansionary boom phase. According to him, long-term changes in the average rate of profit are the main cause of fluctuations in the system and these are related to other fundamental features of the capitalist mode of production (Mandel, 1983: 195-198). Moreover, according to Storper and Walker, science and invention can not be granted such primacy in explaining technological advance or new clusters of innovation, since they themselves are embedded in deeper social and institutional structures (Storper and Walker, 1989: 101). Dosi also argues that although the nature of technical progress is likely to generate long-run changes in economic activity and employment, technology alone does not appear entirely to determine the long-run fluctuations in economic activity and it is not possible to define a self-regulating system whose core adjusting variable is technology (Dosi, 1983: 97).

Although long waves theory is successful in placing the present high-technology phenomenon within a longer term historical context and linking it with the central theoretical dynamic of capitalist economies by attempting to discover whether technological innovations trigger long waves, it does not say where they do this, and when taken literally, it implies a deterministic and regular engine behind the unfolding of history (Sternberg, 1996: 522; Storper and Walker, 1989: 101; Malecki, 1991: 173; Simmie, 1998: 1263 and Thompson, 1989: 129-131). It is true that long wave theory has nothing directly to say about the spatial pattern of high-tech development within countries but implicitly significant differences between successive core industries would probably mean that dissimilar types of raw material would be used and different locations would be favored under each new 'round of investments' (Thompson, 1989: 130-131 and Massey, Quintas, and Wield, 1992: 164). Finally, there is likewise little consensus about the role of the state in regulating long waves as the work of the classical economists Kondratieff and Schumpeter seldomly refers to this issue (Sternberg, 1996: 524). Later publications acknowledge the potential influence of government policy upon the allocation of resources for R&D, and the possibility of alleviating the transition from one technological paradigm to the next, by means of regional innovation policy; especially in the military, an R&D intensive area, the state is at once the most important customer and the most important financier (Sternberg, 1996: 524).

Inspired from Schumpeter, product life-cycle theoreticians bring a deeper look into the macro perspective of long wave theory by focusing on the life cycle of a single product. The product life-cycle model, for its part, claims that each industrial product evolves through a cycle of invariant stages consisting of a development and introductory phase, a growth phase, and a maturity or standardization phase which is temporally open towards the end (Harrison, 1992: 473-474; Storper and Walker, 1989: 119-122; Scott and Storper, 1987: 219, Malecki, 1991: 124-125, Thompson, 1989: 126, Sternberg, 1996: 519, and Oakey, 1985: 109-110). The 'product cycle' explains most of the relations between spatial divisions of labor and technological change by assigning the early phases in the cycle to high-density areas (industrial agglomeration), and the late wage-intensive phases to the periphery (Massey, Quintas, and Wield, 1992: 164; Storper and Walker, 1989: 119-122; Garnsey, 1998; Sternberg, 1996: 519, Scott and Storper, 1987: 219, Thompson, 1989: 126 and Oakey, 1985: 109-110). When product life-cycle theory is integrated with growth pole theories of propulsive sectors, the resulting 'regional lifecycle theory' provides 'a particularly appropriate explanatory framework for understanding the development and impacts of high-technology complexes' (Thompson, 1989: 127). Richardson's 'life-cycle theory of agglomeration economies' also using the concept of autonomous growth centers brings further insights into the 'regional lifecycle theory' (Richardson, 1984: 20). In view of 'regional lifecycle theory' and 'life-cycle theory of agglomeration economies', product cycle theory is also a theory for explaining technology induced regional structural change and regional high-tech clusters (Sternberg, 1996: 519).

Oakey argues that, in terms of the current conceptualization, product life-cycle do not apply to product cycles in many of the newest expanding high-technology industries where there remains scope for the small firm because life cycles for many high-technology products are much shorter (Oakey, 1985: 111). Scott and Storper also argues that "in contradiction to the oversimplified world of the product cycle theorists, what is frequently observed in many cases are radical reversals, changes of course, and unexpected temporal irregularities in patterns of sectoral development (Scott and Storper, 1987: 220). The relationship of technologies and production organization to markets is much more complex and contingent than the product cycle model allows, for both intra-firm and inter-firm responses to changes in the market vary widely from sector to sector (Scott and Storper, 1987: 220). Moreover, new technologies may actually reduce the minimal optimal scale of production and bring about significant reskilling (Scott and Storper, 1987: 220). Oakey adds that high-technology industrial agglomerations are less likely to fail and suffer the problems of innovation stagnation and subsequent decline common to their historical predecessors because their capacity to create new industries ensures continued survival and growth (Oakey, 1985: 113). Thus, the product cycle is, in fact, observable in only a limited number of empirical cases (Scott and Storper, 1987: 220, Oakey, 1985: 111 and Storper, 1995). In the case of regional variants of the product cycle hypothesis, criticism is leveled generally at the inadequate consideration given to company internal matters (Sternberg, 1996: 521).

The 'profit cycle' which was developed by Markusen (1985b) enlarge the micro perspective of product life-cycle in that they conceive of it as referring to the development of whole industries as a result of major technological innovation, rather than as the evolution of a product in the narrow sense (Markusen, 1985b: 27-42; Malecki, 1991: 125; and Thompson, 1989: 131). Product profit-cycle model is distinguished from the conventional product life cycle by its wider sense and its longer time-scale (Thompson, 1989: 131). It suggests that firms in any industry will go through five successive stages of development which consists of the 'zero profit' (corresponding to the initial birth and design stage of an industry - innovative stage), 'super profit' (corresponding to the era of excess profit from temporary monopoly and innovative edge - market penetration), 'normal profit' (corresponding to the stage of open entry, movement toward market saturation, and absence of substantial market power - market saturation), normal-plus or normal-minus profit (corresponding to the post-saturation stage, where either successful oligopolization boosts profits again or predatory and excessive competition squeezes profit), and negative profit stage (corresponding to the obsolescence stage of the sector) (Markusen, 1985b: 27; Amirahmadi and Wallace, 1995: 1751; and Thompson, 1989: 131).

According to Thompson, it succeeds in bringing together strands of business organization, product characteristics, and market imperfections, and placing them in a more general theory (Thompson, 1989: 132). "The main advantages are, first, its widespread applicability to many industries which on the basis of their superficial attributes might otherwise appear quite different, and second, that is seems to hold up well empirically. ... It also opens the way to explaining why high tech is not necessarily always a generator of jobs. ... The drawbacks are primarily those of any stage theory: it is drawn from the empirical observations of trends in known cases, and implies a predetermined unfolding of stages. There is little speculation about underlying reasons why the sequence is so and of whether it is necessarily so. ... The product-profit cycle also offers little explicit guidance as to whether, and how, policy could bring about marked changes in growth rates, stages, or locations - although it does warn most effectively about the complexities of trying to do so, and it does successfully highlight the role of defense in distorting industrial development paths." (Thompson, 1989: 132)

Apart from those cycle-oriented explanations of the genesis and growth of high-tech production complexes, another body of theoretical discourse is locational determinant theory that has a long history in economics, geography, and regional science. Long wave theory and theories of product cycles (life cycle and profit-cycle) are characterized as being aspatial theoretical discourses. This prevents them to capture most of the important factors in high-tech incubation. It is at this point that the main objective of locational determinant theoreticians is to identify factors supposedly attracting firms to given locations (Storper and Walker, 1989: 106 and Malecki, 1991: 203). Thus 'in locational determinants studies it is usually assumed that from a technical understanding of separate characteristics of production and of place can be read off the type of location that is the most desirable for a given industrial activity' (Thompson, 1989: 123). Locational factors approach which can be considered as a recent version of locational determinant theory, involves the construction of lists of location factors which are presumed to define the underlying attractions of particular regions for high technology industry (Simmie, 1998: 1264; Garnsey, 1998: 362; Hall and Markusen, 1985a and Taylor, 1985: 136-137). 'Favourable business climate' (or in Simmie's words 'location-specific factor-cost efficiency within space') is what they refer in general as the main source of high-tech development. It involves a wide range of attractive factors; basic university R&D in science and engineering, accessibility to international airports, nearby military bases, the local availability of venture capital, a high proportion of technical/scientific workers in the local population, a superior quality of life, and so on (Simmie, 1998: 1264; Garnsey, 1998: 362; Hall and Markusen, 1985a; Hall, 1985: 10-11 and Taylor, 1985: 136-137).

Although Maskell and Malmberg (1999: 11-12) argue that the relevance of the Weberian distinction has not tapered off, most of the workers in the field of high-tech development agreed that the classical Weberian theory of location has proven to be limited for explaining the emergence of high technology firms over the economic landscape (Scott and Storper, 1987: 218, Storper and Walker, 1989: 106; Malecki, 1985: 346 and Thompson, 1989: 123-125). According to Maskell and Malmberg, the location factors of yesterday disappear down the list but a new list of the currently most prominent location factors automatically takes shape (such as tacit knowledge (the knowledge assets) and shared trust (learning abilities of local milieus)) as globalization has progressed and transportation costs have diminished in relation to production costs (Maskell and Malmberg, 1999: 11-12). Opponents of the theory have various explanations of inadequacy of locational determinant theory. According to Malecki, "location theory has long underemphasized labor as a location factor but the overriding importance of labor costs in production has substantially negated the traditional role of transport costs in many industries" (Malecki, 1985: 346). As a result, "high technology firms have not only forced greater attention to be paid to labor, but they also have demonstrated vividly that a labor force may be segmented and that the segments may be separated in space from one another" (Malecki, 1985: 346). However, he also notes that "the Weberian model still seems appropriate for such industries as food processing, wood and paper products, oil refining, and petrochemicals, that is, sectors whose inputs are bulky and localized and in which labor continued to be treated as merely a homogenous input like raw materials, for which tradeoffs with transport costs are made."(Malecki, 1985: 346)

For Thompson, Scott and Storper locational determinant theory offers us very little indeed by way of meaningful theoretical generalizations because it misses entirely the central problem of the internal evolutionary dynamics of growth complexes and it tends to yield particular empirical descriptions of locational behavior for the specific industries and places studied (Scott and Storper, 1987: 220 and Thompson, 1989: 124-125). According to them, some industries may not be influenced by locational determinants in a systematic geographical sense. Another empirical objection to the 'success ingredient' model of locational determinant theory is that propitious conditions do not always produce the desired innovative outcome (that is it does not help explain, for example, why places with similar endowments of locational factors can evolve differently, or why the same type of industry took off in different types of places because by definition this approach tends to imply that the factors identified are indeed 'determining') (Thompson, 1989: 124 and Garnsey, 1998: 362). Thompson adds that; it tends to lead to an unrealistic 'partialling out' of individual factors because actual decisions might not be completely rational, but may instead be the result of personal subjective perceptions of an area; even when geographical factors are discernible, they may be fading in importance because they are no longer as unevenly distributed as they once were; last, many factors often thought to be important, such as 'quality of life' and 'university effects', are in any case notoriously difficult to quantify as locational determinants (Thompson, 1989: 124-125).

Inadequacy of the locational determinant theory and cyclical theories of high-tech development in explaining the developments which occurred throughout the 1970s has led to a new wave of theoretical discourses emphasizing mainly production organization, agglomeration economies and social constructs of production. The theory of flexible specialization and production emphasizing mainly production organization and agglomeration economies, later innovative milieux and networks approaches together with learning region and regional collective learning approaches emphasizing mainly socio-spatial constructs of production have emerged as the new theoretical discourses of technology oriented industrial production in 1980s and 1990s.

The theory of flexible specialization and production was developed by Scott and Storper (Scott and Storper, 1987; Scott, 1988; and Storper, 1995). Scott proposed a 'post-Weberian' account of industrial activity, in which the productive and organizational evolution of an industry determines the locational outcomes that are possible. Scott concentrates on both linkages and labor as key, interrelated components of the external milieu. The theory is grounded in the division of labor in production, the structure of inter-establishment transactional activity, co-operative competition, the importance of trust in reproducing sustained collaboration among economic actors within the districts, and the different 'agglomeration economies'[4] that arise endogenously out of localized forms of development (Scott and Storper, 1987: 220; Harrison, 1992: 471 and Thompson, 1989: 132). The advantage of local linkages nurtures small firms that for the most part remain dependent on large corporation (Scott, 1988 and Malecki, 1985: 348). According to this theory, industries are able to influence the character of 'their' region in such a way that the latter corresponds to their specific requirements (Sternberg, 1996: 524). Industries produce economic space rather than being hostage to the pre-existing spatial distribution of supplies and buyers (Storper and Walker, 1989: 106; Sternberg, 1996: 524 and Thompson, 1989: 132).

Scott and Storper argues that 'the increase in extent of the market gives potential for economies of scale in production which can either be realized internally (a system of vertical integration) or externally in a 'production complex' of firms linked together by market *(and quasi-market)* transactions (a system of 'vertical disintegration'[5]) (Scott and Storper, 1987: 220-221). Vertical integration occurs when internal economies of scope are such that the technical division of labor, even when very elaborate, lends itself to internalization under one managerial hierarchy. If internal economies of scope are minor or negative then the fragmented labor processes may separate out into specialized individual firms (Scott and Storper, 1987: 220-221). As the product gains initial acceptance and its market grows, the technical division of labor in production will tend to deepen, also the deepening technical division of labor may be accompanied by an expanding 'social division of labor' between firms specializing in particular intermediate inputs (Scott and Storper, 1987: 220-221). Complexes of transactions-intensive industrial activity by creating 'Verdoorn effects'[6] are, then, likely to appear on the landscape of capitalist commodity production with some frequency. Specialized industrial agglomerations are the geographical means by which producers realize the external economies of scale that are possible with the elaboration of the social division of labor (Scott and Storper, 1987: 221).

The theory of flexible production and specialization reintroduces the concept of industrial districts developed by Marshall[7] at the beginning of this century (Scott, 1988: 176; Amin and Robins, 1991: 106; Harrison, 1992: 469; Castells and Hall, 1994: 223-224; Amirahmadi and Wallace, 1995: 1762; Amin and Thrift, 1992: 575-577; Keeble et al., 1997: 3; Asheim, 1997: 7-21; Hart and Simmie, 1997: 2 and Sternberg, 1996: 524). According to Sternberg, Storper (1993) develops so-called 'technology districts'[8] from the districts characterized by Marshall (Sternberg, 1996: 525). He adds that these 'technology districts' essentially constitute high-tech regions. This theory explicitly places spatial evidence at the center, but accounts for it by making particular use of the findings of business organization theory and applies this to functional-spatial interconnections (Sternberg, 1996: 525).

The prerequisite components of the industrial district model that is based on flexible specialization and production can be listed as following: (Digiovanna, 1996: 374-375, Schmitz, 1995 and Sternberg, 1996: 527). First, industrial districts revolve around specialization. Second, production within the industrial district is invariably characterized as flexible. Third, competition in the industrial district is not centered on cost, but on quality. Finally, the industrial district is driven by constant innovation. Success is highly dependent upon the continues introduction of new production techniques and frequent product improvements. Geographical and sectoral concentration of predominantly of small- and medium-sized firms characterized by the cooperative competition is realized through vertical disintegration and requires an active self-help organization together with a socio-cultural identity facilitating trust (Schmitz, 1995 and Echeverri-Carroll, Hunnicutt and Hansen, 1998: 722). Due to the interplay of these various factors, all firms localized in the industrial district enjoy relative advantages over isolated firms, since there are 'economies external to the firm but internal to the district' (Sternberg, 1996: 527). And high-tech Industrial Districts are unified by their common dependence (directly or indirectly) upon advanced scientific and engineering knowledge, and by their imbrication within capitalist relations of production. (Scott and Storper, 1987: 215; Castells and Hall, 1994: 223-224; Massey, Quintas, and Wield, 1992 and Saxenian, 1990 and 1991).

Making use of 'theories of regulation'[9], the theory of flexible specialization and production attributes the genesis of new industrial regions to the end of the old 'accumulation' regime of postfordism towards the end of the 1970s (Scott, 1988). According to this theory, each new 'ensemble of productive forces and relations' (Scott and Storper, 1987: 225) makes other locational demands, which is why new industries as a rule establish 'their' regions away from the old concentrated spaces (Scott, 1988: 178; Sternberg, 1996: 527 and Thompson, 1989: 133). The key process at work during this phase is vertical disintegration; that is, the spatial outsourcing of production processes into many small business which are closely interconnected with the parent company. When changes in economic conditions bring about intensified uncertainty and instability in production and increased competitiveness in final markets, then internal economies of scale and scope within the firm being to break down so that the entire production system is liable to display strong symptoms of horizontal and vertical disintegration (Scott, 1988: 176). In this way, external economies of scale tend to deepen and widen, and most especially where markets are also expanding so that increasingly specialized service and input suppliers are able to find profitable niches within the total production system (Scott, 1988: 176). An essential precondition for this is the presence of highly flexible local labor markets. In a final stage of this dynamic-evolutionary model of industrial development paths, a dispersion occurs with the development of 'growth peripheries'[10] (Sternberg, 1996: 524 and Cooke, 1983:159). The approach assumes no determined path of regional development, but rather allows for changes in each phase as a result of strategic modifications to the industry (Sternberg, 1996: 524).

From the perspective of regulation theory, Scott's argument is that flexible production has led to deregulation as the main state policy (Scott, 1988). But according to institutionalist there is difference between flexible specialization and *flexible accumulation* in that *flexible specialization* requires a 'high trust' regulatory environment in which the damaging effects of competition are minimized and the preconditions set for 'co-operation among economic actors; both between managers and workers within a firm and between firms and their external subcontractors'. Under flexible accumulation, on the other hand, a Janus-faced state emerges, bifurcated between a dominant 'entrepreneurial state', developing an active program of deregulation, privatization and decentralization, and a subordinate 'soupkitchen state' catering for the unemployed and those on the margins of the post-Fordist economy (Tickell and Peck, 1992: 204). Local and regional states under flexible accumulation gain an expanded and more strategic function with the decreasing of regulative power of national policies. This is known as **'national deregulation-local reregulation'.**[11] It is at this point, Scott and Storper point out that the viability of contemporary flexible production agglomerations depends in high degree upon effective institutional building at the regional level (Tickell and Peck, 1992: 207). Scott believes that effective regulation is necessary because neoconservative mode of social regulation is unlikely to sustain the new regime due to their proneness to market failure (Tickell and Peck, 1992: 207). Tickell and Peck also notes that the paradigmatic example of a 'high trust' environment of mode of social regulation, Emilia-Romagna in Italy, is already beginning to falter, and workable regulation-accumulation couplings in an era of flexible accumulation is necessary (Tickell and Peck, 1992: 207).

There a number of criticism directed toward the theory of flexible production which has led to heated debate between the advocates of alternative theories of regional high-tech growth. The criticism is leveled at its empirical validity, its explanatory value, its heuristic application of the industrial district model, and the its capacity for policy formation and regulation.

According to Thompson, "although Scott and Storper's work (1987: 230) is presented as the beginning of an alternative theory, it actually contains many elements of existing ones" (Thompson, 1989: 133). Their notion of 'ensembles' resembles the core industries in long wave explanations, except that it includes 'productive forces and relations' along with technical economic activity and products. What really distinguishes their contribution is that it is underpinned by the combination of: (1) endogenous capital-labor relations, rather than technological change without social context; and (2) the organization of production in units of firms as a fluid, rather than as fixed, condition (Thompson, 1989: 133). It allows for historical contingencies and particular geographical settings within a sophisticated general framework rather than seeking evidence to support universal laws drawn from one or other of the usual competing economic paradigms. However, it is flexible enough, through its emphasis on transactions-intensive activity and the interaction of scale and specialization, to allow for diverse and opposite spatial outcomes - agglomeration, shifting, and re-concentration - in different times and places (Thompson, 1989: 133).

Harrison and Thompson argue that although some non-market influences (such as military spending in Silicon Valley) on the early stages of high technology development is recognized by the flexible specialization and production theoreticians, the emphasis of the theory on market transactions as the binding system does not seem to offer any explanatory framework for those non-market influences (Thompson, 1989: 133-134 and Harrison, 1994: 322-5). A further weakness is the fact that although the approach professes not only to describe 'new industrial spaces' but also to explain them, it can only describe the first locational choice made by a new technology-induced growth industry as an 'arbitrary locational event' (Sternberg, 1996: 528 and Garnsey, 1998: 365). There is no universal explanation for why the initial concentration of technology intensive industries occurs in some regions but not in others (Sternberg, 1996: 528). In addition, the emphasis on the collection of suitable local labor as a prime reason for attraction to an area does not cover those parts of the high-technology sector which have minimal labor requirements (such as biotechnology), or parts where the need is for key individuals rather than whole specialist work forces (such as in supercomputers) (Thompson, 1989). Moreover, in many high-tech markets there is in particular a lack of functioning markets as prerequisites for vertical disintegration induced by transaction costs with successive re-agglomeration (Thompson, 1989).

For Thompson and Sternberg, the theory of flexible production has little consideration for political influence. Thompson argues that in the theory there is practically nothing to indicate that technology policy has an influence on industrial or technology districts as their overall picture of the development of the new space-economy offers limited immediate tangible information of direct use for policymakers, who have little hope of affecting the nature of the capital-labor relation or of significantly altering laws upholding property rights (Thompson, 1989: 133-134). Sternberg also argues that in the logic of theory of flexible production there

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is little room for political influence because according to the theory, it is exclusively the firms that are able to manage regional development (industries 'produce' regions - the approach is argued exclusively from the point of view of industry or the firm) (Sternberg, 1996: 528). However, as Tickell and Peck (1992: 207) note, Scott has explicit consideration for regulation and policy formulation (Scott, 1988). Sternberg also says that just recently Scott has commented on the subject of 'policy'. Scott assumes that regions with flexible production can only exist in the long term if local policy responds to the specific needs of these types of region (Sternberg, 1996: 528). But Sternberg maintains that Scott does not build an explanation of his recent findings (1988) into his theory. According Sternberg, Malecki (1991), on the other hand, at least makes it clear that the influence of government policies in the period of flexibility is fundamentally different from that during the fordist mode of production.

According to Sayer, "buzz words like 'flexibility' are initially attractive because they offer the promise of escape from old concepts whose limitations are all too familiar and whose strengths bore rather than impress" but "they quickly die because their promise proves to be false, their unities and generalisations full of holes" (Sayer, 1988: 670). He argues that there is also need for further evidence in order to prove the existence of increased 'products differentiation' which is associated with flexibility (Sayer, 1988: 674). According to him, the fact that flexible specialization literature relates increased flexibility to a growth of small-batch production at the expense of mass production and to decreasing firm size also needs some examination (Sayer, 1988:675). In addition, in Marxist terms vertical disintegration and the development of networks of related firms would seem to involve a deepening of social division of labor at the expense of the technical division of labor (Sayer, 1988: 678). Lastly, he argues that the need for proximity can be a function of organizational form rather than a cause of it - it is the small size of some firms which makes them unable to afford to market over long distances (Sayer, 1988: 679).

A possibly more serious criticism is leveled at the inevitable validity of the model. Florida and Kenney argue that flexible specialization can turn into a start-up mania and overspecialization which makes it difficult for high-technology firms to combine one or more technologies into new hybrid innovations or to generate systems technologies (Florida and Kenney, 1990: 78-80). Although a cooperative community of high-technology firms and their suppliers is certainly a desirable ideal, the reality is a competitive war of all against all in which the outcome is tremendous profit for some and exhaustion for many others (Florida and Kenney, 1990: 76). As noted by Scott himself the externalization of transaction costs by vertical disintegration constitutes only one possibility for firms to react to uncertain markets.

The emphasis on specialization and the lack of differentiation by size is another shortcoming of the industrial district model based on flexible specialization among predominantly small firms (Echeverri-Carroll, Hunnicutt and Hansen, 1998: 722; Schmitz and Musyck, 1994 and Schmitz, 1995). Echeverri-Carroll et. al, Schmitz and Musyck argue that some of the small firms grow so big that they start controlling other small ones. Thus, according to them, network systems are not exclusive to small firms and networks between large firms and small firms are also important in the competitiveness of industrial districts. Scott (1992) also shows that large producers in industrial districts can play a constructive role and the extensive internationalization of modern capitalism is not necessarily in opposition to the formation of industrial districts.

According to Sternberg, "the fascination with the theories of flexible specialization/ production and industrial districts lies in *the fact that** they can explain a part of current regional development processes" (Sternberg, 1996: 529). However, three essential shortcomings substantially reduce their value as theories. Firstly, flexibility is more a matter of industrial organization on a global rather than on a local or regional scale as multinationals with their global networks have by far more impact on the world economy than locally embedded firms (Amin and Robins, 1991: 110; and Hassink, 1997: 9). Amin and Robins (1991: 115) argue that the process of restructuring today involving powerful tendencies towards global rather than local organizational networks does not point to self-sustaining local economic development. Secondly, at the present time flexible economies in the form of industrial districts constitute a tiny minority of all regions, which is why they are better described as exceptions that confirm the rule of non-flexible regional economies based on international innovation networks between large concerns (Sternberg, 1996: 529). There is a lack of evidence to speak about a theory that has general validity for the reason that only a few success regions are analyzed in an anecdotal way (Hassink, 1997: 9). Thirdly, so far there has been hardly any serious attempt to use the theory of flexible production to formulate promising strategies of regional economic policy (Sternberg, 1996: 529).

Another theoretical framework sharing many characteristics of flexible specialization and production is constituted by combination of innovative milieux and network approaches together with regional collective learning and learning region approaches.

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* Italics in quotations are mine.

The milieu approach was developed in the mid-1980s by regional economists in the GREMI (Groupe de Recherche Européen sur les Milieux Innovateurs) group. "In the milieu approach, innovations and innovative firms are the result of a collective, dynamic process involving many agents within a region which together form a network of synergy-producing interconnections. According to this approach, the milieu, that is the socio-economic environment of a region, is produced by the interactions of firms, institutions and workforce that, through a common process of cooperative learning, reduce uncertainties during changes in technological paradigms. This process of learning from and with one another is brought by the mobility of employees, interconnections between suppliers, and in the form of face-to-face contacts which are aided by spatial proximity. In principle all participating agents profit from the advantages to be gained from regional networks; but the biggest benefits are enjoyed by small firms. A characteristics feature of those firms that are integrated in the network is their interdependence combined with simultaneous autonomy, which is expressed in close cooperation in spite of intensive competition." (Sternberg, 1996: 529) The influence of policy is explicitly taken into account in the milieu approach. The principle agents in an innovative network include public institutions, firms and workforces. The closely interconnected network and milieu approaches are intended primarily as explanations for the genesis of innovation (Sternberg, 1996: 529).

Necessary conditions for an innovative milieu to emerge include (Crevoisier and Maillat, 1991: 16-18, 25-26; Camagni, 1991: 130; Castells and Hall, 1994 and Castells, 1996: 82-83): (1) the know-how and information which can be acquired from region's training and education institutions, leading universities and educational institutions, government R&D institutions, private/public research institutes, and networks of R&D institutions; (2) a sufficiently large pool of mobile employees (scientists, technicians and qualified workers); (3) production capital; the availability of investors who are prepared to finance plans that are fundamentally risky in the sphere of new technologies; and (4) market relations. By milieux of innovation it is referred to the social, institutional, organizational, economic, and territorial structures that create the conditions for the continuous generation of synergy and its investment in a process of production that results from this very synergistic capacity, both for the units of production that are part of the milieu and for the milieu as a whole (Castells and Hall, 1994: 7). According to Crevoisier and Maillat (1991: 19), although the milieu is deduced from a number of elements which themselves are regionally located, it does not necessarily refer to a geographical entity. However, Castells argues that in the case of high-tech industries, spatial proximity is a necessary material condition for the existence of such milieux, because of the nature of interaction in the innovation process (Castells, 1996: 82).

Camagni (1991: 142) also argues that territoriality of the *milieu ('synergy space')* is apparent for proximity plays a necessary (but not sufficient!) role in the creation of local synergies.

The analysis of networks is older than the milieu idea and can already be seen in Myrdal's theory of 'cumulative causation'[12] and Perroux's theory of 'growth poles'[13]. However, in the regional sciences networks have long been considered from purely the micro-economic perspective of the firm, and only in the form of connections between suppliers (Sternberg, 1996: 530 and Asheim, 1997: 7-8). It is only as an integral component of milieu theory that the concept of networks is given an explicitly regional context and is intended to include a large number of very different forms of interconnections between various agents (Sternberg, 1996: 530 and Maillat et al., 1995: 261).[14] According to Camagni (1991: 140), 'milieu' relationships and 'network' relationships appear as complementary and mutually reinforcing 'operators'[15], the former linking the firm to its contiguous environment through mainly informal and tacit relationships, the latter linking it explicitly to selected partners in its operational environment.

On the other hand, the milieu and the networks can be also distinguished very clearly. The interconnections in the more agent oriented network are long-term arrangements; they are often contractually-formally assured and of a cooperative nature, and are directed toward a goal (Camagni, 1991: 135; Jaskari, 1997; and Sternberg, 1996: 530). In the region-oriented milieu, on the other hand, there are looser links between the agents who are not necessarily dependent on one another (Camagni, 1991: 135; and Sternberg, 1996: 530). Milieu relationships consist of network relations of a mainly informal and tacit nature (Camagni, 1991: 135). According to Camagni, 'network' may be defined as a closed set of selected and explicit linkages with preferential partners in a firm's space of complementary assets and market relationships, having as a major goal the reduction of static and dynamic uncertainty (Camagni, 1991: 135).[16] An innovation network is composed of the economic actors (individuals, institutions) who directly take part in an innovation process and of the formal (or quasi-formal) relations that they develop in that circumstance (Perrin, 1991: 35). According to Perrin (1991: 36) and Camagni (1991: 142), networks (*'cooperation space'*) also appear to be linked to territorial environmental conditions.

Critics directed towards the network and milieu approach is generally related with their empirical evidence. "The milieu approach comes under criticism primarily because of its lack of operational feasibility and the small amount of empirical evidence to support it. Neither the milieu in general nor the innovative milieu in particular is clearly defined. The spatial context often remains unclear. The same shortcoming is also true in the case of the innovative networks." (Sternberg, 1996: 532) "Publications devoted to the subject of 'innovative milieux' have hitherto been of a predominantly qualitative and theoretical nature. Empirical studies are also confined to innovative regions (often high-tech regions) for which the existence of an innovative milieu is prerequisite." (Sternberg, 1996: 532) A further criticism concerns the inadequate integration of the primarily *agent-oriented theory of the network* into the *region-oriented milieu approach.*

Regional collective learning and learning region approaches are the most recent theoretic works on high-tech regions. Learning region concept has been launched from three angles (Hassink, 1997:1). First, it has been seen as the spatial outcome of grand societal changes (theoretical-structural perspective).[17] Secondly, there are discussions going on about the relationship between entrepreneurial learning, innovation and spatial proximity (theoretical, actor-related perspective).[18] Thirdly, the learning region has been presented as a new theory-led policy concept (such as industrial districts and innovative milieus and policy-oriented innovation stimulation concepts) for regional economic development in which intraregional and interregional learning among policy-makers, intermediaries and companies is stressed (action-related perspective). It is the theory-led model of the learning region that has clear insights for the creation of high-tech industrial districts.

Advocates of the theory-led future model of the learning region assume that with particular policy measures one can increase companies' dependence on regional partners for technological learning and thus on the location itself (Hassink, 1997: 2). Asheim (1997), for instance, sees learning regions from an institutional point of view. *In his eyes learning regions are the predecessors of 'traditional' industrial districts.* The challenge for learning regions is both to increase the innovative capability of SME-based industrial agglomerations through identifying which milieu fosters innovation and to find a way to benefit simultaneously from tacit 'contextual' knowledge of industrial districts and from codified knowledge of the global economy. According to Asheim, the concept of 'learning regions' is precisely developed to describe such a region with an economy embedded in 'institutional thickness', and characterized by innovative activity based on localized, interactive learning, and cooperation promoting (organizational) innovations in order to secure competitiveness. A transition of, for example, industrial districts into 'learning regions' could exploit 'the benefits of learning based competitiveness' (Asheim, 1997: 10).

Together with 'Marshallian agglomeration economies', 'disembodied technical knowledge'[19] and 'untraded interdependencies' constitute the material basis for the formation of territorial embedded regional systems of innovation as an alternative to regionalised national systems of innovation represented by science parks and other top-down technology policies based on the linear model of innovation (Asheim, 1997: 9). According to Massey et al. (1992: 71), classical model of linear model of innovation and its dominance on the economy prevents the transition into the informational economy which is characterized by emergence of high-tech industrial district on the world scene as the new form of industrial production which is not only a 'space using activity'[20] but at the same time in socio-cultural and technological terms a 'space creating activity'[21]. Perroux's perspective on the importance of agglomerations together with the Marshall's 'industrial atmosphere' can find also support from modern innovation theory, originating from new institutional economics, which argues that regional production systems, industrial districts and technological districts are becoming increasingly important (Asheim, 1997: 7).[22]

Hassink argues that "a region with mainly regionally oriented independent SMEs is better served with a regionally embedded innovation system than a region with large enterprises and their suppliers or a region with mainly branch plants" (Hassink: 13). Thus, according to modern innovation theory, it could be argued that regions dominated by (territorial agglomerated) SMEs can develop a large innovative capacity as a basis for endogenous regional development. The extent to which a learning region concept or regional innovation system can affect the regional economy lies on a continuum between two extremes: fully dependent on exogenous decisions and full endogenous control. Since these two extremes are far away from reality, in order to stay competitive, regions must integrate locally specific competencies with codified, generally available knowledge, or, in other words, they must link their own innovation systems with national innovation systems and international knowledge flows (Hassink, 1997: 13). Thus, there is always a need for 'enterprise support systems, such as **technology centers** or **service centers**, which can help keep networks of firms innovative' (Hassink, 1997: 6).

The learning region concept clearly shows many similarities to existing above-mentioned concepts. The main difference between learning region and others is that learning region concept enriches the classical agglomeration effects with new contents such as tacit knowledge and untraded interdependencies (Hassink, 1997: 13). Moreover, development of the learning region as a regional development concept has strengthened the relationship between economic geography and policy advising and consultancy. In comparison with existing concepts in economic geography, the theory-led learning region concept is much more focused on a direct transfer of academic insights to local and regional innovation policies. Furthermore, the learning region concept could serve to solve the question what distinguishes 'good' from 'bad' industrial agglomerations.

GREMI European School of Regional Economic Research associated with Aydalot, Camagni and their fellow workers has developed another concept, 'collective learning', to connote a broad notion of the capacity of a particular regional 'innovative milieu' to generate or facilitate innovative behavior by the firms which are members of that milieu (Keeble et al., 1997: 1). Although the networks and processes themselves are viewed as influential in the recent evolution of dynamic regional clusters of innovative small and medium-sized enterprises, *regional collective learning approach emphasizes* the relationships of trust and reciprocity on which processes of exchange and development of technological expertise and high rates of technological and product innovation are based (Keeble et al., 1997: 1).

Camagni argues that reducing or eliminating 'competence gap' demands the development by the firm of effective 'transcoding functions' which 'translate external information into a language which the firm may understand' (development of functions which can merge both codified and tacit information into firm-specific knowledge, including R&D knowledge) (Camagni, 1991, 127). For Camagni, a successful regional innovative milieu embodies 'hidden, mainly tacit functions', in the form of 'a collective learning process' operating 'mainly through skilled labor mobility within the local labor market, customer-supplier technical and organizational interchange, imitation processes and reverse engineering, exhibition of successful 'climatisation' and application to local needs of general purpose technologies, informal 'cafeteria' effects, complementary information and specialized service provision.

By extension, regional collective learning can be understood as the emergence of basic common knowledge and procedures across a set of **geographically-proximate** firms which facilitates co-operation and solutions to common problems (Kirat and Lung, 1999; Maskell and Malmberg, 1999: 20 and Keeble et al., 1997: 2). This requires the establishment of common tacit codes of conduct and the formation of common 'representations' and widely shared 'beliefs' on products and technologies, an aspect of regional collective learning which is likely to be encouraged by 'synergy effects stemming from a common cultural, psychological and often political background, sometimes enhanced by the effectiveness of some local 'collective agent' (Camagni, 1991, 133-134 and Keeble et al., 1997:2-3).

According to Kirat and Lung, territory is to be endogenized and this can be realized on the basis of institutional-collective learning processes (Kirat and Lung, 1999). Territory is created in constructing a common framework for representing and comprehending behavioral choices by means of institutional proximity. Thus, according to them institutional proximity which is a prerequisite of collective learning is more conducive to territory and geographical proximity is meaningful as part of this territory (Kirat and Lung, 1999). Hudson also argues that 'the networks through which learning is enabled and expressed are not necessarily territorially defined and demarcated and is some respects the growing sophistication of IT and communications technologies has weakened this link further' (Hudson, 1999: 64). However, he recognizes the fact that 'some networks are without doubt deeply spatially embedded and recognition of this provides a bridge into more general notions of the significance of territorially based knowledge to economic competitiveness and success' (Hudson, 1999: 64).

Similar to the resemblance and reciprocality between *innovative milieux and network approaches*, Keeble et al. also argues that the concept of regional collective learning clearly bears many similarities and connections with 'the learning region' (Keeble et al., 1997: 3). However, it is important to stress that the latter seem to place emphasis more on the role of **'non-firm' institutions** or organizations - governments, training organizations, development agencies, universities, etc. - in shaping regional innovative capacity, than perhaps on networking and the intensity of interaction between individual firms, with which regional collective learning is primarily concerned (Keeble et al., 1997: 3).

Maybe the most surprising similarity is between 'the learning region' and 'network approaches' together with the similarity between 'innovative milieux' and 'regional collective learning'. On the one hand, the former two approaches emphasize the importance of formal relationships and the role of agents. On the other hand, the latter two approaches place the emphasis on informal relationships and the role of individual firms.

The above-mentioned theoretical concepts assume that geographical concentration of industrial activities positively affects competitiveness. This correlation, however, is not watertight (Hassink 1997). As milieus tend to change more slowly than industries, a '*sclerotic* milieu' can remain in a region even after the industrial structure to which it belonged already has disappeared.[23] The regions that are able to adjust their institutional endowment to meet contemporary demands of the firms also require 'un-learning' (Hassink 1997; Maskell and Malmberg, 1999: 14 and Hudson, 1999: 68). Lack of unlearning often goes hand in hand with an increasing resistance towards new ideas, a growing bureaucratic inertia and a general organizational degeneration, especially when the firm is operating in generous markets (Maskell and Malmberg, 1999: 14). Lastly, according to Hudson, 'the concept of the learning region and the proposition that regional economic success reflects specifically regional assets and institutions for the production and dissemination of knowledge is hardly a new one' (Hudson, 1999: 67). He argues that 'the fetishization of knowledge and learning, and their institutional bases, may lead to a neglect of other institutional factors that underlie regional competitiveness' (Hudson, 1999: 68).

Both the network approach and the argument put forward by the milieu approach and learning region approach together with regional collective learning have also clear affinities with the theory of flexible production and specialization (industrial district). Although advocates of the milieu approach emphasize that a milieu does not have to be limited to one region, spatial proximity substantially increases its effect and innovative milieux utilize local territorial organization (*flexible production)* as a means of integrating the formal and informal collective processes essential to the production of permanent innovation (Sternberg, 1996: 529-530). Also common to both is the use of industrial districts. For some authors the milieu and the industrial district are even identical and historically networks are generally seen being equivalent to agglomeration economies available through optimal location in geographic space (Sternberg, 1996: 530 and Asheim, 1997: 7-8). Still for some other authors, learning region is complementary to industrial districts (Asheim, 1997:10; Keeble et al., 1997:3; and Hassink, 1997).

High-tech industrial district under the light of the above theoretical discussions and practical evidences refers to territorially embedded networks of vertically disintegrated small and medium sized firms constituted throughout a high-trust environment within a synergistic atmosphere of innovation by using the local tacit knowledge, the venture capital and flexible sci-tech labor market created by R&D institutes in close proximity to agglomeration. This magic formula is of little importance due to lack of any serious attempt to use it to formulate promising strategies of regional economic policy. A more realistic formulation of high-tech industrial development requires a detailed investigation of a wide range of high-tech industrial districts all over the world. An evaluation of the world experience of high-tech development is presented in the following table that is based on the detailed literature review of important high-tech industrial districts all around the world.

Table 1 - Key Factors in Development of High Technology Communities.

HIGH-TECH REGION	COUNTRY	Local Univer-sities	State-provincial and local government policies	Federal government institutions and programs	Private sector activity - spin-off, venture-capital
Silicon Valley	USA, California	●		●	●
Route 128	USA, Boston	●		●	●
Silicon Mountain; Denver-Boulder Region	USA, Denver	○	◑	○	●
Silicon Valley North; Ottawa's Technology Oriented Complex	Canada, Ottowa			●	○
Silicon Island; Kumamoto Technopolis	Japan, Kumamoto	○	◑	●	◑
Shinanogawa-Nagaoka Technopolis	Japan, Niigata	●	○	●	◑
Tsukuba Science City	Japan	●		●	
Kansai Science City	Japan	◑	●	●	●
Britain's M4 Corridor	UK, London	◑	○	◑	●
Hertfordshire	UK, London	◑		◑	●
Silicon Fen; Cambridge Science Park	UK, Cambridge	●	○	●	●
Aston Science Park	UK, Aston	●	●	○	◑
Oxford Science Park	UK, Oxford	◑	◑		◑
Silicon Glen; Heriot-Watt Research Park	UK, Scotland	●	◑	○	●
Matam R&D Park	Israel	◑		●	●
Tefen Technopark	Israel	◑		◑	●
Kiryat Waizmann Science Park	Israel	●		◑	●
Silicon Riviera; Sophia Antipolis	France	◑	◑	●	◑
ZIRST Industrial Zone	France, Grenoble	◑		●	◑
Ile-de-France	France, Paris	◑			◑
Swiss Jura Arc	Switzerland	◑	●	●	◑
Jæren	Norway	◑	●	◑	●
Hsinchu Science City	Taiwan	◑		●	●
Taedok Science Town	Korea	◑		●	○
Kumi Industrial District	Korea			●	●
Beijing Industrial District; Electronics Street	China	●	◑	○	◑
Akademgorodok	Russia	◑		●	
Network Program	Denmark		●	●	
Innovation Centers (ICs)	Germany		●	◑	○
Baden-Württemberg	Germany	○	◑	◑	●

●-Critical; ◑-Very important; ○-Important

Source: Adapted from Steed and DeGenova, 1983.

What is emerging from this table is that high-tech industrial developments lie on a continuum between two extremes: fully dependent on exogenous decisions (spontaneous growth) and full endogenous control (planned occurrences). Since these two extremes are far away from reality, each high-tech industrial district differentiates between two occurrences and falls somewhere between them. In this context three basic types of high tech development can be identified when the initial motivation provided by institutions are considered. The first one covers those planned cases where the basic motivation of high tech development is provided throughout the conscious and planned efforts of several local and especially central government agencies. The planned cases is typical in Asian nations, where strategic investments, especially by central government, are intended to create technology-oriented cities to serve as engines of growth for their respective regions.

The support of government is not always a direct one but it can be through certain incentives and carefully designed policies. This constitutes the second type of motivation of high tech industrial development. Tax incentives, provision of technological know-how, free use of government and university R&D labs etc. can be listed as incentives provided by local or central government. Geographically technoparks and innovation centers in Europe and USA exemplify second type of high-tech industrial development. This second category can be divided into two sub-groups: On the one hand, the support of government is directed to attract high-tech firms to a park site in vicinity with a university. On the other hand, government R&D institutes around themselves create the initial incubation centers with the help of strong procurement linkages and information flow.

The last type of high tech development covers those most market oriented and at the same the most successful high-tech industrial districts. Such as Silicon Valley in California where technology-oriented region have developed as a result of the uncoordinated actions of private business who happen to locate together due to the presence of commonly valued attributes, especially research universities, good climate and, perhaps, small-scale government investments. In these high-tech industrial districts the growth is principally the product of locally initiated firms and spin-offs.

Categories and types drawn here are transitional rather than strictly defined ones. Although relatively distinct, these archetypes may overlap and a single high-tech industrial district may contain elements of more than one model. The typology should therefore be viewed largely as a vehicle illustrating the focus of activities and the major mechanisms contributing to developing a high-tech industrial district and building a region's comparative advantage.

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Overlapping of these three types of world experience of high-tech development and the theoretical discussions on high-tech regions brings about the regulative content of theories discussed (Table 2). Policy implication of this regulative content is too limited and there is need for further assessment of theoretical approaches in terms of their general validity for the explanations of dynamics of high-tech districts. Table 3 shows the initial potentials of theoretical discourses with respect to their appropriateness for the explanation of genesis and growth of high-tech regions, and for the formulation of technology policy. What emerges from Table 3 is that theory of flexible specialization and production together with two groups of approaches (innovative milieux and network approaches together with learning region and regional collective approaches) seems to provide a better understanding of high-tech regions and to have a greater capacity for policy implications. When the theories are evaluated according to some key aspects of high-tech regions, theory of flexible specialization and production emerges as the most appropriate theory of high-tech regional growth and development (Table 4). The fact that explanations of theories overlap with each other makes it difficult to highlight the differences among them. However, as explained before, all the recent approaches on high-tech development have clear affinities with the theory of flexible production and specialization (industrial district paradigm).

Table 2 - Matching of theoretical discourses and types of high-tech development.

Type of high-tech development	*Planned occurrences*	*Mixture of two extremes (Planned and Spontaneous)*	*Spontaneous growth*
Matching theoretical discourse	*Locational Determinant Theory*	*Theory of Flexible Specialization and Production*	*Learning Region and Innovative Milieux-Networks Approaches*

In accordance with this theoretical foundation and relevant world practice, dynamics of high-tech industrial districts necessitates the confirmation of following set of statements as the prerequisites of the existence of any high-tech industrial district:

Emergence of High-Tech Regions

- The classical perception of the causes of the high-tech existence and development as a linear path of development prevents real synergy and miss the central importance of cooperation between industrial production and R&D.
- High-tech development is not independent of local socio-economic and socio-spatial considerations. It is highly territorially embedded but territorial embeddedness of high-

tech industrial production does not prevent its development somewhere else.

- Central government, directly or indirectly, plays important roles in constituting high-tech region. The involvement of national technology policy and thus government in creating high-tech region is inevitable. Ranging from absolutely planned developments to spontaneous occurrences, there are different mixes of government involvement.
- Government procurement of high-technology products together with defense spending provides the main motivation behind most of the high-tech developments. The technical specifications of the military products ensure the sustained combination of scientific knowledge and industrial production.
- The local self-help institutions are also very important in information dissemination and collaborative action. It is sometimes local governments and self-help organizations that give birth to high-tech industrial region.

Evolution and Transformation of High-Tech Regions

- The incubation phase for a successful high-tech region requires the constitution of real synergy between R&D and production. Venture capital together with government supports and procurements transform the synergistic atmosphere of innovation into a viable high-tech region.
- As high-tech region mature into a viable economic entity, it develops a network structure conducive to innovations and generally immune to cyclical fluctuations. It is spontaneous interacting which is characterized by the mature phase of development of high-tech industrial district. Spontaneous interacting can take two different forms of occurrences; synergic integration which is characterized by custom products and strategic disintegration which is characterized by standard products.
- The spin-offs from R&D institutes (sci-tech entrepreneur) form the base of high-tech production. The localized codified knowledge prevents the transfer of competitive capacity to other regions.
- The final stage of development for a high-tech region involves the decentralization of all routinized production function to periphery and transformation of the region into an innovation and high-tech product design center.

Regulation of High-Tech Regions

- Central government policies may play important roles in the creation of high-tech regions. Government intervention is realized throughout certain regulatory tools that cover a wide range of information and financial incentives. Special tax treatments, duty free imports of factory equipment and raw materials, bank loans with low interest rate, education and training programs to upgrade the technological knowledge of workers, provision of land and government procurement of technological products can be listed among the regulatory tools used in the formation of high-tech firms.

- The dominance of government institutes is beneficial in incubation phase of a high-tech region but they may be harmful in the growth phase. The high degree of dependence of the high-tech firms upon the central government policies can harm the entire region. The dominance of private sector activity can occur in the mature phase of growth of high-tech region and it is the only way through which a viable high-tech region is created.
- Cooperation between public and private sector is a necessary condition of high-tech incubation. Producing technology requires great amounts of capital and well-educated innovative scientists. Venture capital and government procurements of high-tech products provide high-tech firms with continuous development of their technological base.
- Universities clearly play a significant role in the formation of some of the high-tech complexes, but that does not mean that high technology complexes necessarily can only germinate in proximity to universities. Government R&D Institutes are more conducive to creation of high-tech region than university R&D in that they are directly involved in high-tech production as partners and consumers.
- As a policy intervention to provide a more balanced growth, high-tech policy intrinsically reproduce a tension in itself. And it is for this reason that many attempts fail to be successful.

Structural Characteristics of High-Tech Industrial Districts

Innovation Atmosphere

- Innovation atmosphere requires spatial proximity between production and R&D units. However, this spatial proximity does not guarantee the creation of innovation atmosphere.
- It is the synergetic actions that guarantee the formation of real innovation atmosphere. The problem is that synergy can not be absolutely planned but it can only be intended.
- The basic factors which lead to synergetic actions consists of a high-trust environment of networking, local codified knowledge and the will for interacting in creating new

technologies.

- Thus, a high-trust environment is a necessary condition of innovation oriented production. And local codified knowledge (localized interactive learning) is an indicator of successful high-tech region.
- A significant proportion of prescriptive knowledge cannot be comprehensively codified and this gives birth to an evolving industrial cultural atmosphere and increasing competitive power.

Networks and Production System

- High-tech firms are naturally and predominantly small and medium ones. Spin-off nature of high-tech firm constitution necessitates this fact.
- Vertical disintegration together with trust and reciprocity (untraded interdependencies) constitute the basic principles of innovation in high-tech regions. The cost and risk of developing new products are spread across networks of autonomous but interdependent firms.
- Interfirm alliances established for joint product developments are the source of technological upgrading and an important indicator of powerful high-tech base.
- The decentralization of production and reliance on networks is not limited to small or new firms seeking to avoid fixed investments. Even large producers have restructured internally to gain flexibility and technical advantage.
- Innovative firms are generally based on trust based networking which is superior to rule dependent ones in that it provides its members with the real synergy, and thus innovation as the repercussion.
- It is quality subcontracting rather than quantity subcontracting, which distinguishes the high-tech regions from other regions. In an environment that demands rapid new product introductions and continual technological exchange, this is a necessity of staying alive.
- The formation of common representation thus the shared challenges and the cooperation is necessary to develop viable high-tech environment.

Labor Market

- Scientific workforce constitutes the majority of the high-tech labor market. But the mature phase of high-tech development is characterized by the increased number of qualified technicians.

- A structured labor market is a natural outcome of the high-tech industrial development. It is both a source of development and increasing social polarization. High-tech regions epitomize and reinforce precisely a particular form of the division of labor where the possession of increased skills by some deprives others of the ability to develop their own potential. This dual structure of labor market shapes also the social stratification and structuring of the urban landscape. High-tech firms are also fiercely anti-union and have been so since the beginning.
- Informal interaction, informal dress, a non-hierarchical structure are all features of this labor market. Scientific workers are seen explicitly as 'human capital'. In innovative firms within the general scientific/technical area, there is no grading or other formal divisions. Informal cafeteria effects are also very important for the diffusion of information.
- Craft apprenticeship system over high-tech production leads to the sci-tech-middle-class disdain of physical production. Consequently, this constitutes a hindrance on the use of innovative capacity created by scientist because the sci-tech class does not want to participate in technical activities.
- In high-tech regions, generally there is no formal time recording of attendance of the staff. Staff work on projects basis and there is a low level of supervision on them but workers in general overcompensate for this flexibility.
- The mobility of mental labor is necessary to sustain and ensure the diffusion of technological know-how and development. But high labor mobility is associated with the rise of vicious cycle of labor shortages and consequently vicious cycle of wage increases.

Some part of this long list of statements which reveal high-tech industrial districts can have some unfamiliarity with the Turkish context as Turkish high-tech industrial districts constitution experience is currently limited to the creation of Technology Development Centers (TDC) and Technoparks. Although there are some intentions in order to create some potential high-tech industrial districts, it is too early to judge whether they will be successful or not. Instead, under light of theoretical discourses and relevant world practice it is better to judge whether TDCs and Technoparks are in accordance with the successful world practice and they have potential of becoming viable high-tech agglomerations. The initial findings indicates that Turkish high-tech policy which is based on linear model of innovation need to be revised and redefined on the base of current world practice which gives more premium to new concept such as synergy and trust-based networks.

Table 3 - Assessment of theories under the light of the practical and theoretical evidences.

Theories of high-tech development	The Main Focus	Practical Evidence	What is the relative information to be obtained		Policy Formulation
			Genesis	Growth	Possibility
Locational Determinant theory	Listing of Locational Factors attracting high-tech firms	Japanese Technopolis Program, Science Parks of United Kingdom, Tsukuba, Akademgorodok, Taedok, Hinschiu Science Park, Kumi Industrial District	◑	◑	◑
Theory of flexible specialization and production (industrial district paradigm)	Production Organizations, Technology and Agglomeration effects	Third Italy, Silicon Valley, Route 128, Ottowa's TOC, Beijing,, M4 Corridor, Silicon Glen, Silicon Fen, Baden-Württemberg	●	●	●
Innovative milieux and networks approaches	Production networks, Technology	Sophia Antipolis, Network Program in Denmark, Silicon Valley	●	◑	◑
Learning region and regional collective learning approaches	Tacit knowledge, Technology, Agglomeration	Silicon Valley, Silicon Fen, Oxford Science Park, Jæren, Swiss Jura Arc	◑	●	◑

● very appropriate, useful explanations; ◑ partly useful explanations; ○ not appropriate, no useful explanations

Source: Adapted from Sternberg, 1996.

Table 4 - Evaluation of usefulness of appropriate theories of high-tech development in testing the statements derived from practical evidence.

	Appropriate Theories of High-Tech Development		
Important constituents of high-tech industrial districts	Theory of Flexible Specialization and Production (Industrial District Paradigm)	Innovative Milieux and Networks Approaches	Learning Region and Regional Collective Learning Approaches
Dominance of small and medium sized firms	◑	◑	◑
Innovative firms	●	●	●
Cooperative competition	●	●	◑
High-trust environment	◑	◑	●
Venture capital	●	◑	○
Local codified knowledge	●	◑	●
Synergetic atmosphere	●	●	●
Socio-cultural identity	◑	◑	◑
Flexible sci-tech local labor market	●	●	●
Local self-help organizations	◑	◑	●
Production networks	●	◑	◑
Intra-firm organizations	●	◑	◑
Agglomeration economies and spatial proximity	●	◑	◑
Universities and other R&D Institutes in close proximity	●	●	◑

● Strongly emphasized – ◑ Emphasized - ○ Mentioned

Outline of the study

Following the preceding relation of theoretical background and evaluation of high-tech industrial districts, it is now possible to visualize the conceptual framework of these regions. The next chapters of the thesis which enlarge the understanding of why and how high-tech industries develop in a specific location and not in others aims to shed some light on the possibility of replication of them in Turkey. For this purpose, in the next four chapters the main effort is to clarify structural characteristics and regulation mechanisms of high-tech industrial districts, and consequently to draw a picture of current Turkish high-tech context in order to derive some policy implications specific to Turkey. On the base of this logic, this study can be outlined as below:

Elucidation of the dynamics of high-tech regions requires the identification of the common characteristics of high-tech agglomerations. In the second chapter of the thesis, the structural characteristics of the high-tech regions are identified and discussed in detail. Structural characteristics of high-tech regions are explained on the base of structural elements of constitution of high-tech base. Innovation atmosphere, production networks and organizations, and high-tech labor market that constitute the main structural elements of the creation of a high-tech base are analyzed and discussed. Lastly a conclusion for the second chapter is drawn on the base of these structural characteristics.

In the third chapter of the thesis, the regulation mechanisms of the high-tech regions are identified and discussed in detail. In order to reach best practice, there is need to understand the internal dynamics of each regulation system employed in the creation of high-tech regions. Ranging from strictly interventionist systems to fully spontaneous growths, there is a wide range of regulation mechanisms. An attempt to categorize them into different models of regulation mechanisms is realized to provide a better understanding of current world practice. Following this, main components of regulation mechanisms are defined and given in detail in order to shed some light on the evaluation of Turkish experience.

Consequently, in the forth chapter of the thesis high-tech industrial development experience of Turkey together with the case studies is presented. First, national plans which defines the framework for developmental supports are judged with respect to the practical evidence on technological development set in them in order to highlight how far they recognize the problems associated with high-tech development in accordance with the current world practice. Second, high-tech production and incubation centers of Turkey are analyzed by grouping them according source of initiatives. Following this, high-tech regulation mechanism of Turkey is analyzed. In order to realize this, main actors of the regulation mechanism together with high-tech incentives and encouragement schemes provided by them are identified and discussed in detail. Later, Turkish legislation about high-tech regions is analyzed. Lastly, case studies conducted in Ankara, İzmir, Kocaeli and İstanbul are presented in order to shed some light on the success of the Turkish high-tech centers.

Except for ATRP (Anadolu Technology Research Park), nearly all of the existing technology centers and technoparks are visited. Selection of firms to be interviewed are realized in such a way that portfolio of interviewed firms covers both successful and unsuccessful firms. It also covers firms graduated from the technology centers. Thus, interviews are not limited to the firms located at technology centers. Firms being graduated from the centers and located somewhere else were also visited. Before the interviews, directors of the centers were requested to determine the sample successful and unsuccessful firms in accordance with firms' success in commercializing their projects. They were also requested to determine sample graduated firms. In addition to this, firms other than the ones chosen by the directors were also selected to be interviewed in accordance with the available written documents on the topic and interviews held at SMIDO. Selection of this last group of firms was realized in order to eliminate the misdirection of the directors.

In the conclusion chapter of the thesis, there is an evaluation of Turkish high-tech industrial district constitution experience and following this there are some policy implications for further development.

CHAPTER 2

STRUCTURAL CHARACTERISTICS OF HIGH-TECH INDUSTRIAL DISTRICTS

2.1. Innovation Atmosphere

High-tech industrial district should be considered as an indispensable part of the learning region (as a global transformation) which is one of the most important characteristics of the new emerging socio-spatial regulation that we face in the next millennium. What is not changing in the changing world is the phenomenon of changing itself. Due to this fact there is an increasing need to learn more and more. This learning should not be considered only in terms of understanding and capability of adapting new technologies and innovations, it should be rather considered as a rule of the game and as a continuos process throughout the whole lifetime. Thus, nowadays information has importance as much as capital in investment decisions and knowledge has turned into being another factor of production. This creates a chance and capacity for many localities to be integrated with the new global networks of economic and social relations. Regional planners will need to restructure 'innovation techniques' specifically to accommodate high-tech industries and to design policies that correlate with the industrial objective of competitive advantage.

In this section the historical evolution of innovation process is highlighted and emerging models of innovation is identified as they shed some light on the understanding of how and why high-tech industrial districts are created. Later the factors of innovation is presented and the role of each one in the creation of innovation atmosphere is explained in order to highlight their potentials as triggers to innovation.

2.1.1. Models of Innovation and Historical Evolution of Innovation Process

Historically two different models of innovation can be observed from the world experience of high-tech growth. Table 5 shows the matching between types of high-tech industrial development and innovation models, and Table 6 shows the comparison of models of innovation with reference to some key factors.

Table 5 - The matching of innovation systems with different types of high-tech industrial development.

Type of high-tech development	*Planned occurrences*	*Mixture of two extremes (Planned and Spontaneous)*	*Spontaneous growth*
Matching innovation system	*Linear Model of Innovation*	*Interplay of Linear and Interactive Models of Innovation*	*Interactive Models of Modern Innovation Theory*

2.1.1.1. Linear Model of Innovation; Mass Production - Top-Down Initiatives

War-periods' defense spending on high-technology showed that scientific knowledge is very central to technological innovations in production as scientific innovations and their subsequent implementation in war machines had changed the fate of the wars. Today military procurement of high-tech products still plays important roles in high-tech development and in most of the high-tech industrial districts defense spending helps the survival of innovation capacity (Saxenian, 1985: 25-8; Simmie, 1998: 1261; Breheny, Cheshire, and Langridge, 1985: 129; Hall and Markusen, 1985a: 145-150; Hassink, 1997: 9; Steed, 1987: 262-8; Steed and DeGenova, 1983: 266-76; Storper, 1993: 444-6; Castells and Hall, 1994: 16-9, 240-1; Florida and Kenney, 1990: 82; Harrison, 1994: 322-5; Massey, Quintas and Wield, 1992: 6; Saxenian, 1984: 170; Scott and Storper, 1987: 216-220; Scott, 1992: 271; Weiss, 1985: 88-9; Sternberg, 1996: 524-32). Technological development owes much to the war-periods' spending of the 'Warfare State' (Table 7). Being effected from war periods' experience, naturally, innovation was seen as a linear process of progression beginning with the inventions in University or Government R&D Laboratories and ending as a final product. The nature of innovation has changed. It need not, and now commonly does not, consist in an individual inventor making a major advance and then interacting with other inventors in a network (Dosi, 1988). The increasing complexity of research and innovative activities militates in favor of formal organizations (firms' R&D labs, government labs, universities) as opposed to individual inventors (Dosi, 1988).

Table 6 - Comparison of models of innovation with reference to regulatory mechanisms.

Innovation System		High-Tech Regions	Matching Theoretical Discourse	Local Univer-sities	State-provincial and local government policies	Federal government institutions and programs (gov. R&D)	Private sector activity - spin-off, venture-capital
Linear Model of Innovation		Akademgorodok, Taedok, Tsukuba, Technopolis Program, UK Science Parks	Locational Determinants Theory (LDT)	● ◑	○ ◑	●	○ ◑
Interplay of Linear and Interactive Models of Innovation	*With Relative Dominance of Linear Model*	Hsinchu, Kansai, Silicon Riviera, Silicon Glen and Fen, Tsukuba	Theory of Flexible Specialization and Production (+) LDT	◑	○ ◑	●	◑
	With Relative Dominance of Interactive Model	Silicon Valley, Silicon Valley North, Swiss Jura Arc	Theory of Flexible Specialization and Production (+) LR & IM	◑	○ ◑	◑	●
Interactive Models of Innovation		Jæren, Silicon Valley, M4 Corridor, Silicon Valley North, Route 128	Learning Region (LR) and Innovative Milieux (IM) Approaches	○	○ ◑	○	●

● Critical, ◑ Very important, ○ Important.

Table 7 - National R&D expenditures as a per cent of GDP by Country, 1975-93.

Years	Total R&D						Non-defense R&D					
	USA	Japan	Germany	France	UK	Italy	USA	Japan	Germany	France	UK	Italy
1975	2.22	1.91	2.24	1.79	2.05	0.84	1.61	1.90	2.10	1.44	1.42	0.83
1980	2.31	2.01	2.45	1.82	-	0.75	1.76	2.00	2.33	1.41	-	0.74
1985	2.82	2.58	2.72	2.25	2.27	1.13	1.98	2.56	2.58	1.78	1.68	1.06
1990	2.73	2.89	2.75	2.42	2.19	1.30	2.01	2.61	2.61	1.85	1.81	1.25
1991	2.80	2.87	2.65	2.42	2.13	1.32	2.11	2.53	2.53	1.92	1.73	1.26
1992	2.77	2.80	2.53	2.36	2.12	1.38	2.10	2.42	2.42	1.92	1.71	1.33
1993	2.67	-	-	-	-	1.40	2.02	-	-	-	-	1.25

Source: With minor changes adapted from Welfens, Audretsch, Addison and Grupp, 1998.

The emerging first argument, consequently, was that the innovation can be realized throughout a linear model which introduces a several-stage innovation process beginning with an academic or research idea which is gradually transformed into finished new goods (Figure 1) (Massey, Quintas and Wield, 1992: 71, Hassink, 1997: 3 and Malecki, 1991: 114-123). Being affected by the 'Fordist' production techniques innovation was coupled with strong managerial centralism and the search for giant economies of scale (Hudson, 1999: 62-66). In order to disembody knowledge and know-how acquisition of which by workers increase their negotiation power with employers, the production process was broken up into a myriad of separate and deskilled tasks whose pace was controlled by the speed of the line rather than the inclination of the individual worker (Hudson, 1999: 66). Consequently, separate R&D departments and a linear model of learning and innovation within the firm had emerged and this separated manual from mental labor and privileged the latter over the former, and privileged codifiable formal scientific knowledge over the practical and often tacit knowledge of the skilled manual worker (Hudson, 1999: 66). Under the pressures of Fordist giant economies towards more vertical integration of industrial production, innovation was highly internalized as an in-house firm activity *and* with the growth of big industrial laboratories in major corporations, innovation has become routinized and bureaucratized (Castells and Hall, 1994: 224-225). Thus, the linear innovation model can be considered as part of the Fordist industrial and societal organization, in which formal knowledge, research-based and codified knowledge, large enterprises, national systems of innovation have dominated (Hudson, 1999: 62-66; Asheim, 1997: 9; Hassink, 1997: 3; and, Massey, Quintas and Wield, 1992: 71).

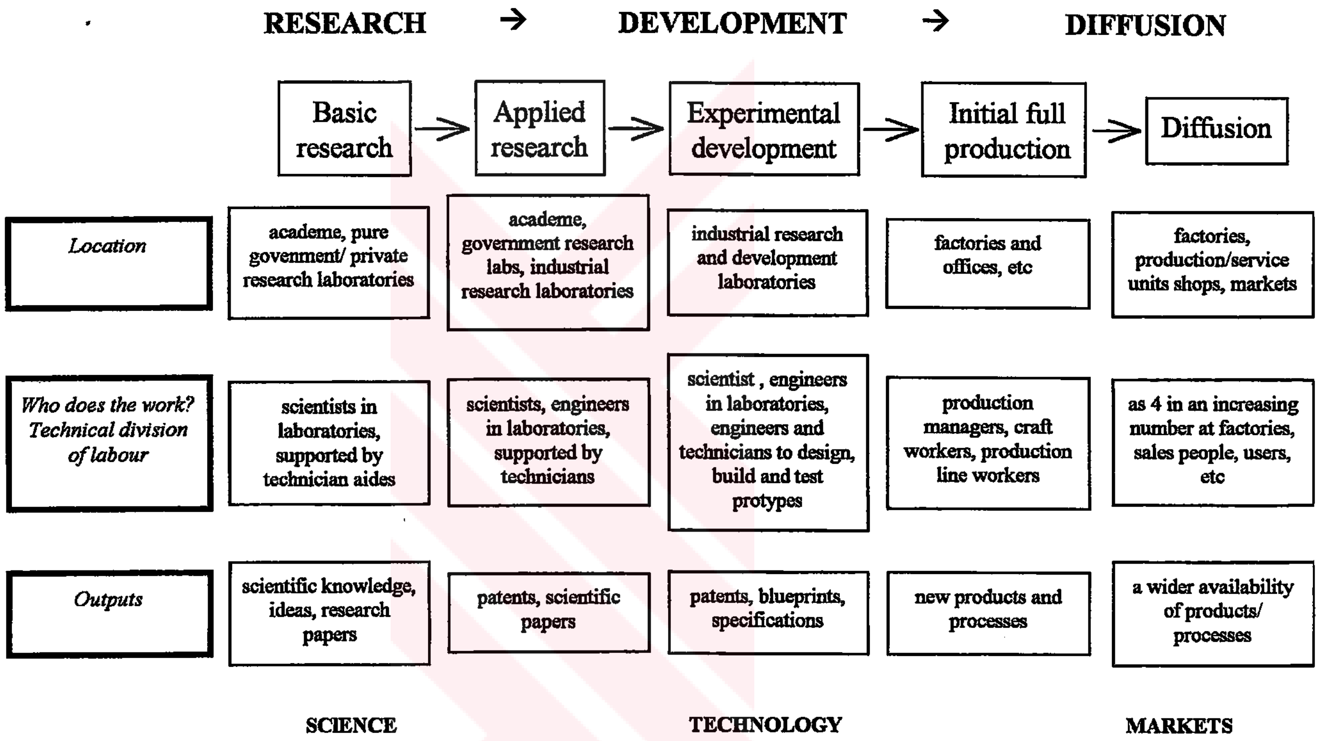

Figure 1 - The linear innovation model.
Source: Massey, Quintas and Wield, 1992: 57.

This had also constituted the main rationale behind the first planned high-tech developments all over the world. Accordingly the first strategy which employed the linear model of innovation in production had became the constitution of techno- and science-parks. At the core of these development lies the view that scientific activities are performed in academic laboratories isolated from other activities prevents the innovation. In order to transform the resulting discoveries and knowledge of Universities and Research Institutes into potential inputs to technology, it is believed that Research and Production activities should be realized in close proximity to each other (Castells and Hall, 1994: 240-241; Hassink, 1997: 10, Asheim, 1997: 9 and, Massey, Quintas and Wield, 1992: 56). This initial motivation had breeded technology oriented small firms and later transformed some of them into large-scale production complexes (such as Silicon Valley and Silicon Fen).

But the rise of more specialized markets in which quality and choice are increasingly valued over quantity and uniformity have helped the proliferation of niche market oriented small and medium sized firms all over the world (Piore and Sabel, 1984). Small and medium-sized firms increasingly out-competed the giants by producing the best-quality products for the smaller niche markets and changing production runs more flexibly. In turn, to keep their markets, large corporations increase their practice of breaking up into smaller business units, each with its own design, marketing, R&D and so on, and with the power to use sub-contractors as well as in-house sourcing (disintegration - vertical fragmentation) (Piore and Sabel, 1984; Hudson, 1999: 62; Florida and Kenney, 1990: 78 and, Amirahmadi and Wallace, 1995). Flexible specialization and production realized by dense networks of small and medium sized producers has introduced a new theory of innovation into the literature; modern innovation theory and its models (interactive innovation models).

2.1.1.2. Interactive Models of Innovation; Flexible Production - Bottom-Up Initiatives

Critiques of the simplistic nature of the linear model paved the way for modern innovation theory. The most obvious implication of critiques of the linear model is that learning, knowledge-acquisition and other transformative impulses flow in more than one direction, and there can be no one model of the way innovation takes place (Massey, Quintas and Wield, 1992: 83; Dosi, 1988; and Morgan, 1997: 495). Massey et al. argue that "rather than a several-stage innovation process beginning with an academic or research idea, which is gradually transformed into finished new goods, the conception is that innovation requires the integration of all skills (marketing, design, production and R&D) at all stages of the process. The linear model of innovation does not fit such new forms of industrial innovation"

(Massey, Quintas and Wield, 1992: 71). Dosi also argues that technical change is a cumulative activity and it is not a simple response to changes in market conditions. Directions of technical change are influenced by the state of technologies already in use.

The fatal weakness of linear model of innovation is that it involves no feedback loops (learning by using and interacting - supplier and customer linkages) and within this model there is an unwarranted disdain for certain kinds of knowledge (learning by doing - engineering and production know-how) (Massey, Quintas and Wield, 1992: 81; Morgan, 1997: 493; and Hudson, 1999: 62). The emphasis now is therefore upon recognizing that innovation is an interactive process that involves the synthesis of different types of knowledge rather than privileging the formal scientific knowledge of R&D laboratory over other forms of knowledge (Morgan, 1997: 493 and Hudson, 1999: 62). To put this differently, there is a vast range of technological knowledge embodied not so much in published literature as in the minds and muscles of many varieties of working technologists (Massey, Quintas and Wield, 1992: 81). This technological knowledge embodied in the minds and muscles of many varieties of working technologists is called as tacit knowledge. The fact that tacit knowledge is inexpressible does not mean that it is any the less knowledge. "Furthermore, the growing significance of the symbolic meanings attached to consumption, a fortiori in circumstances in which the commodity is an event or spectacle rather than a material object, places an even greater premium on knowledge of consumer tastes and on the ability to shape them via advertising." (Hudson, 1999: 62) In a significant number of industrial sectors, it is user companies and organizations rather than producer companies that are more innovative. One implication of this in the context of innovations is that revolutionary innovations may be produced in unexpected ways.

Shortly, five major differences can be drawn between linear model of innovation and more interactive models of modern innovation theory (Massey, Quintas and Wield, 1992: 83). First, there is not just one process of innovation, that from research to commercialization; rather, new ideas are generated and developed at all stages of innovation, including in production. Second, basic research is not the only initiator stage. Third, rather than just being used as the eureka beginning-point of innovation, research results are used, in one form or another, at all stages of innovation. Fourth, the relationship between basic research and commerce is too complex to be understood as a straight-line relationship with a complete divide between phases. Fifth, the linear model devalues the contributions of most of the people (workers and users) involved in innovation.

Examples of alternative models of modern innovation theory range from the system-team approach of some innovative Japanese companies to the use of skilled workers in manufacturing innovation in (West) German industry, to experiments in Sweden with more open work environments, to the three-in-one teams of the Chinese cultural revolution (Massey, Quintas and Wield, 1992: 84-85). Each alternative is different from each other. However, all the alternatives share some characteristics that counterpose them to the linear model underlying science parks (Massey, Quintas and Wield, 1992: 85 and Asheim, 1997: 9). They imply far more interaction, and at times real integration, between what the linear model would conceptualize as separate stages of the innovation process. For example science- and techno-parks' foundation on such a separation, and indeed the insistence that it is not just a social but also a spatial separation, are potentially problematical (Massey, Quintas and Wield, 1992: 85). The linear model implies a strong division of labor for it increases the separation of mental and manual work (Massey, Quintas and Wield, 1992: 85 and Hudson, 1999: 66).

Under the light of the above discussions regional innovation systems can be grouped into two different categories (Asheim, 1997); the regionalised national innovation system in which parts of the regional production structure and institutional infrastructure in a region functionally belong to the national innovation system (examples are large PREs, technopoles or science parks that are often implemented into the region in a *top-down* way and that are thus limitedly anchored in the region) and the regionally embedded innovation system in which both the regional production structure and institutional infrastructure are embedded and established in the region in a bottom-up way (interactive innovation model). Spatial proximity and agglomeration make the establishment of the latter model easier. And territorial embedded regional systems of innovation can be considered as an alternative to regionalised national systems of innovation represented by science parks and other top-down technology policies based on the linear model of innovation (Asheim, 1997: 9).

Thus, according to modern innovation theory, it could be argued that regions dominated by (territorial agglomerated) SMEs can develop a large innovative capacity as a basis for endogenous regional development. At the regional level the challenge is to increase the innovative capability of (especially) SME-based industrial agglomerations through identifying 'the economic logic by which milieu fosters innovation' (Storper, 1995: 203). Generally, it is important to underline the need for enterprise support systems, such as **technology centers** or **service centers**, which can help keep networks of firms innovative. This points to the importance of disembodied technical progress, i.e. progress 'which can occur independently of changes in physical capital stock', and 'untraded interdependencies', i.e. a structured set of technological externalities which can be a collective asset of groups of firms/industries within countries/regions (Asheim, 1997: 8-9).

2.1.2. Factors of Innovation and Their Role in Constituting Innovation Atmosphere

Globalization has led to the ubiquitification of previously important location factors and emergence of a new set of location factors. Tacit knowledge (social proximity) and shared trust (dynamic relational proximity) have increased in importance as new localized capabilities that increase the competitive power of the local firms (Maskell and Malmberg, 1999: 17; Camagni, 1991; Hassink, 1997: 5 and Asheim, 1997: 15). Extended trust and tacit knowledge constitute the basis for inter-firm cooperation and networking, and helps to sustain collective efficiency defined as 'the competitive advantage derived from local external economies of joint action' (Asheim, 1997: 15). Conventions and routines that dictate trust relations may help to regulate economic life by reducing uncertainty. "In purely economic terms trust is an extremely valuable resource, not least because it saves a lot of trouble to have a fair degree of reliance on other people's word. But also due to the fact that one cannot buy trust." (Morgan, 1997: 493) Where trust based relations dominates the networks, lawyers or written contracts are rarely used (Maskell and Malmberg, 1999: 18).

Trust and common understandings also contribute to **regional** and **social embeddedness** that may facilitate information transfer (Fuellhart, 1999: 43). Trust can be best developed at the regional level because this is the level at which regular interactions, one of the conditions for trust-building, can be sustained over time (Morgan, 1997: 501). Local setting may be particularly critical when a substantial portion of information flow is tacit in nature since effective knowledge transfer can be dependent upon a high degree of mutual trust and understanding which may have critical spatial foundations (Maskell and Malmberg, 1999).

Thus, trust seems to be crucial and valuable both when decisions to redesign interfirm linkages are being made and once a link has been forged. But from where does such trust emanate? What reproduces it? The answer of the theorists of the districts is - from experience. Trust is built up over a period of time, through continual and repeated transactions, through contracting and re-contracting, through informal deal-making, through one firm or group's offering assistance to another in moments of stress, through mutual reinforcement in responding to contingency, through mutual commitments not to abandon each other during downturns or to exploit advantages during upturns, through learning the fact that opportunistic behavior is severely penalized, through sharing the same beliefs, values and convictions, which can make certain types of exchange and corporation easy (Saxenian, 1990: 103; Maskell and Malmberg, 1999: 18; Harrison, 1992: 477; Saxenian, 1991: 431; Morgan, 1997: 493; and Glasmeier, 1999: 82). Trust which facilitates coordination and cooperation for mutual benefit can be considered as a form of social capital created by institutional routines and social conventions which together with interactive learning constitute the material evidence of 'learning economy' (Morgan, 1997: 493).

"Trust and cooperation among firms can be also intentionally created through a 'partnership' strategy, which is based on establishing long-term relations concerning the amount, price and quality of work between the client firms and their subcontractors. *Although, there are* the possibilities of creating trust by bringing in consultants in order to make groups of firms capable of redefining their collective interests so as to pave the way for 'studied trust', ... it is questionable if the intentional creation of trust between networking firms can be 'embedded' in the same way as the original form of 'mutual knowledge and trust' found in Marshallian industrial districts". (Asheim, 1997: 15) At least it is clear that the intentional creation of trust can not replace the localized combination of incentives and penalties which acts as the crucial component in a transmission mechanism preparing new generations to accept the existing environment and concede to its behavioral constraints (Maskell and Malmberg, 1999: 19).

When it comes to the production of trust, high-tech agglomerations have two advantages (Maskell and Malmberg, 1999: 19 and Asheim, 1997: 16). First, manufacturers do not only have to rely on their own experience but can exploit the experience of others (shared trust establishes an environment that facilitates the relatively easy exchange of knowledge). Secondly, agglomerations facilitate joint actions aiming at building up institutional trust. **Schemes** or **centers** that promote, assure, and certify quality are unlikely to emerge without joint initiatives from foresighted manufacturers (Asheim, 1997: 16). However, the importance of trust as a prerequisite to promote inter-firm cooperation as a basis for competitiveness is not a guarantee in itself for a sufficient degree of innovativeness in the long run (Asheim, 1997: 16). It is the creation of mutual tacit knowledge and reciprocity that helps to sustain continuos innovation.

Formation of the real innovation atmosphere can only be realized in a synergetic atmosphere of mutual trust, reciprocity and tacit codes of conduct. This formation process can be analyzed conceptually in two different scale; intra-firm and inter-firm scale: Intra-firm scale,

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DOKÜMANTASYON MERKEZİ

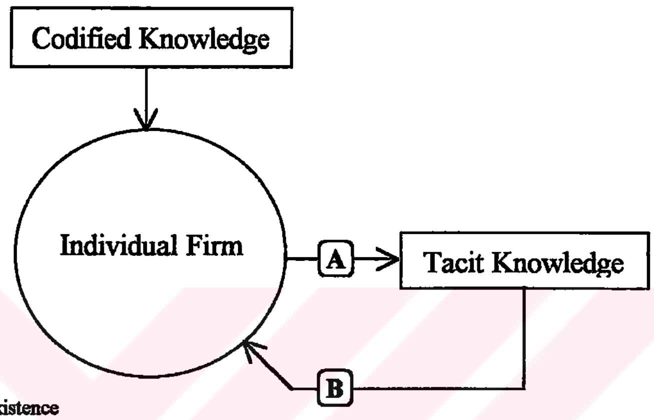
as illustrated in Figure 2, for innovation relies on 'tacit knowledge'[24] which is a byproduct of in-firm production activities. Without the inter-firm alliances and cooperation, the vicious cycle of in-firm tacit knowledge creation can not be converted into virtuous cycle of creation of locally codified knowledge. Inter-firm scale, as illustrated in Figure 2, for innovation relies on locally codified knowledge which is a byproduct of inter-firm networking. The process of producing locally codified knowledge highly depends upon the institutional structure of the high-tech region. On Figure 2 the paths labeled as B shows the creation of competitive advantage in the form of production of locally codified knowledge. Path C illustrates the option for globalization.

What emerges from the above analysis of formation of innovation atmosphere is the fact that codification of tacit knowledge is a trade-off between localization and globalization. Asheim argues that codified knowledge can eliminate the specific 'context conditions' of the districts and seriously damage their innovativeness and competitiveness as the knowledge in the form of embodied technical progress can be exported independently of social institutions (Asheim, 1997: 10). Although they argue that some degree of codification is indispensable for obtaining economies of scale and scope, Maskell and Malmberg also believe that the codification of tacit knowledge is a process very similar to the process of ubiquitification that prevents the local competitive advantage. According to them, any codification of a piece of knowledge will eventually lead to its diffusion, thereby undermining the present possessor's possibility of using it as an ingredient in sustaining competitiveness (Maskell and Malmberg, 1999: 16). In this way, the knowledge loses its potential to contribute to the competitiveness of the firm. According to them, how firms can go about protecting their knowledge assets from losing value by codification is establishment of shared trust (Maskell and Malmberg, 1999). Asheim also suggests that some part of the key tacit knowledge should not be codified in order to preserve the competitive advantage of the region as such knowledge in its disembodied form can not be absorbed independently of social institutions (Asheim, 1997).

The knowledge form also determines to what extent proximity is necessary for learning and innovation. Although the exchange of information is not constrained by space, the exchange of tacit knowledge is indeed constrained by geographical distance and tacit knowledge is highly geographically immobile as in order to communicate tacit knowledge 'code keys', which are only understandable if (social) coherence and proximity are available, are needed (Echeverri-Carroll, Hunnicutt and Hansen, 1998: 727; Asheim, 1997: 9-10 and Hassink, 1997: 5). Saxenian and Hassink point out this as below:

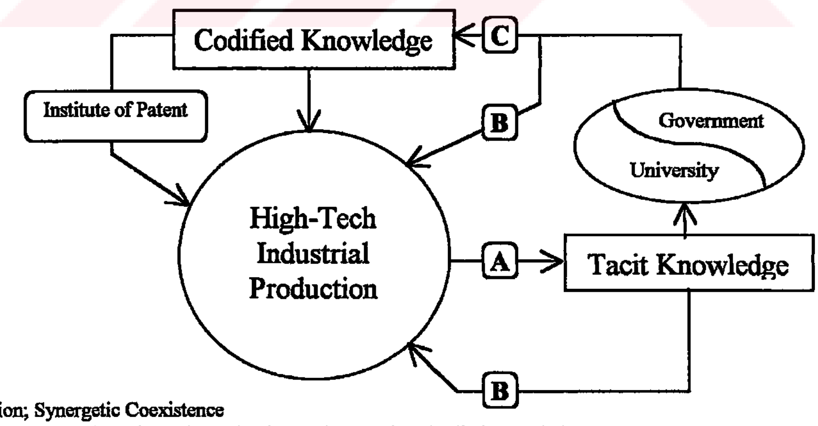
"A distinct language has evolved in Silicon Valley and that certain technical terms used by semiconductor production engineers in the region would not even be understood by their counterparts in Boston's Route 128. The localization of technical know-how and skills encourages an ongoing process of learning by problem solving among the region's semiconductor and computer firms and the variety of linked industries." (Saxenian, 1990: 98)

Intrafirm Innovation



A Innovation; Synergetic Coexistence
B Internalization; Creation of in-house R&D

Atmospehere of Continuous Innovation



A Innovation; Synergetic Coexistence
B Localization; Creation of Local Production Culture (Disembodied Knowledge)
C Globalization; Diffusion of Innovation

Codified Knowledge → Synergetic Atmosphere of Innovation → Tacit Knowledge

Figure 2 - Conceptual Framework of Modern Innovation Theory.

> "The more knowledge is tacit, complex and part of a larger system, the more relevant are informal means of knowledge transmission, like 'face-to-face' talks, personal teaching and training, mobility of personnel, and even acquisition of entire groups of people. Such means of knowledge transmission are extremely sensible to the distance among agents." (Hassink, 1997: 5)

In the current knowledge-based economy, all these findings infer that firms in the high-tech industrial areas must either shield some valuable pieces of knowledge from becoming globally accessible, or be able to create, acquire, accumulate and utilize codifiable tacit knowledge a little faster than their competitors (Maskell and Malmberg, 1999: 16). It is the trust-based relations through which this can be realized. Trust-based relationships are primarily built as trust is not a commodity readily available on the market. When building trust-based relationships between firms, some forms of tacit knowledge might eventually be exchanged (Maskell and Malmberg, 1999: 17).

2.2. Production Networks and Organizations

World experience of high-tech industrial development shows that high-tech networks can be constituted generally in two different ways of interacting; regulated and spontaneous interacting (Table 8). Regulated interacting generally requires a strong involvement of government agencies and aims at incubating innovation by employing mission oriented subcontracting relations. Spontaneous interacting, on the other hand, is characterized by the predominance of firms themselves and relies on trust based actions of firms. In contrast to regulated interacting, spontaneous interacting is intrinsically profit oriented and flexible in character. The comparison of two different ways of interacting helps to identify three important points. First, the world experience shows that trust based networking is superior to rule dependent ones in that it provides its members with the real synergy, and thus innovation as the repercussion. Second, it is rather mission oriented networking which is most observable at the incubation phase of high-tech region and profit oriented networking which is most observable at the mature phase of high-tech region. Third, regulated interacting is characterized by the emphasis given on agents in the creation of networks rather than firms.

Forms of interacting overlaps with three different network structure; bureaucratic, flexible and overflexible networks. Bureaucratized networks are sclerotic in nature. It is the real lesson of Akademgorodok, Taedok and early history of Swiss Jura Arc that high-regulation systems of bureaucratized networks prevent real synergy occurring through networking. The quality of the research institutes in both Taedok in Korea and Akademgorodok in Russia was very high but little synergy resulted from the spatial proximity between the institutes as bureaucratic rules prevented high levels of interaction between institutes themselves and industry (Castells and Hall, 1994: 56-57). In their incubation phase, both in Taedok and Akademgorodok, there was no industrial zone. Industrial firms were explicitly isolated from R&D institutes. On the other hand, the main problem in Swiss Jura Arc was the rigid rules of the cartel formed by Swiss watch manufacturers themselves in an attempt to increase their competitiveness and profits (Maillat et al., 1995 and Glasmeier, 1991). Being as an absolute closed system of networking, cartel had prevented the adaptation of Swiss watch industry to new innovative technologies.[25]

Table 8 - Forms of interacting and network structures.

<table>
<tr><th></th><th colspan="2">Regulated Interacting</th><th colspan="2">Spontaneous Interacting</th></tr>
<tr><td>Main motivation</td><td colspan="2">Mission oriented</td><td colspan="2">Profit oriented</td></tr>
<tr><td>Supporters</td><td colspan="2">Government Agents</td><td colspan="2">Firms themselves</td></tr>
<tr><td>Dominant phase</td><td colspan="2">Incubation phase</td><td colspan="2">Mature Phase</td></tr>
<tr><td>Emphasizes</td><td colspan="2">Innovation</td><td colspan="2">Innovation and Product</td></tr>
<tr><td>Forms of relations</td><td colspan="2">Instructive-Organizative</td><td colspan="2">Flexible-Collaborative</td></tr>
<tr><td>Source of synergy</td><td colspan="2">Rules and conventions</td><td colspan="2">Trust based actions</td></tr>
<tr><td>Matching networking system</td><td>Bureaucratic Network Structures</td><td colspan="2">Flexible and Steered Network Structures</td><td>Overflexible-Overspecialised Network Structures</td></tr>
<tr><td>Practical Evidence</td><td>Akademgorodok, Taedok and early history of Jura Arc</td><td colspan="2">Other high-tech regions</td><td>Silicon Valley and Route 128</td></tr>
<tr><td>Matching model of labor mobility</td><td>Limited Labor Mobility and Synergic Innovation</td><td colspan="2">High Labor Mobility and Innovation</td><td>High Labor Mobility and Innovation</td></tr>
</table>

World experience inevitably confirms that it is mostly flexible and overflexible network structures with which the synergetic atmosphere of innovation is associated. Thus, the aim of this section is to identify the functioning of these network structures. For this purpose, characteristics of production networks prevailing in a high-tech industrial district are analyzed and different types of production networks are drawn. Later characteristics of high-tech firms' intrafirm organization are highlighted.

2.2.1. Characteristics of High-Tech Production Networks

The high-tech industrial production system which is based on knowledge-intensive organizations is characterized by a horizontal specialization or complementarity in products (Saxenian, 1990: 91; Keeble et al., 1997: 1; Asheim, 1997: 7-12; Castells and Hall, 1994: 2-3; Florida, 1995: 535; Florida and Kenney, 1990: 69 and Storper, 1993: 434). The informational economy seems to be characterized by new organizational forms whcih can be described as a change from a domination of vertical relations between principal firms and their subcontractors to horizontal relations between principal firms and suppliers. Horizontal networks substitute for vertical bureaucracies as the most productive form of organization and management. Flexible specialization replaces standardized mass production as the new industrial form best able to adapt to the variable geometry of changing world demand and versatile cultural values (Castells and Hall, 1994: 2-3).

Horizontal networks open access to various sources of information and thus offer a considerably broader learning interface than is the case with hierarchical firms. However, to achieve this it is important that the networks are organized in accordance with the principle of the '**strength of weak ties**'. Loose coupling within networks affords for favorable conditions for interactive learning and innovation (Asheim, 1997: 11-12). Through networking the ambition is to create strategic advantages over competitors outside the network. Using this perspective on networks, competitive advantage is achieved internally through inter-firm cooperation and exploited externally through competition with firms of the outside world Asheim, 1997: 15). The importance of horizontal forms of cooperation with respect to promoting innovations highlights the qualitative aspects of networking (Asheim, 1997: 11).

Small and medium sized firms are the main players of the horizontal network structures. All the recent theories of high-tech industrial development point that networks or communities of small firms are a more effective form of economic and technological organization than are large integrated companies. The cost and risk of developing new products are spread across networks of autonomous but interdependent small firms. In an environment which demands rapid new product introductions and continual technological exchange, no one firm can complete the design and production of an entire product on its own. By relying on networks of suppliers - both within the region and more distant - firms gain the flexibility to introduce increasingly sophisticated products faster than ever before. 'Flexibly specialized' networks of small firms are characterized by close relationships, shared trust, and intense cooperation in the development and production of new products. Firms cooperate with one another in the development of new products making it possible for them to remain small but still be globally competitive.

However, fragmented atomic structure may be also harmful to the existence of high-tech regions in certain periods of time. The twentieth-century history of the Swiss watch industry illustrates how cultures and industrial production systems experience great difficulty adapting to external change at different points in time. The emphasis on production networks - unique reservoirs of potential technological innovation realized through cooperation rather than competition among firms - lacks a detailed appreciation of historic networks, and in particular their fragile character in times of economic turmoil. While networks can and do promote innovation within existing technological framework, historical experience suggests that their fragmented, atomic structure is subject to disorganization during periods of technological change (Glasmeier, 1991: 469 and Florida and Kenney, 1990: 78). The history of the Swiss watch industry is instructive as countries and regions experiment with network production systems in attempts to maintain and augment their competitiveness in a global economy.

The real lesson of Swiss Jura Arc is that n*etwork rigidities hamper industry response*.[26] As the Swiss case attests, elaborate network production systems suffer like any other organizational form in the face of unexpected technological change.

> "The peculiar advantage of decentralized systems are also potentially their greatest flaw. Extreme change often necessitates radical reorientation. In such instances the ability to respond rapidly dictates who will be the ultimate victors. Although watches represent a specific case, their longevity as a product should bring pause to pronouncements that network production systems are somehow immune to technological change." (Glasmeier, 1991: 483)

In similar ways, American high technology also suffers from an extreme form of vertical as well as horizontal fragmentation. Vertical fragmentation means that various functions of the firms, ranging from R&D to manufacturing, are parceled out into independent firms, where each aspect of the production chain is the province of a separate group of specialized companies (Florida and Kenney, 1990: 78). "The production of customized chips is a case study in vertical fragmentation. Custom chips (application-specific integrated circuits, or ASICs) are designed by specialized design firms, produced by independently owned foundries, and assembled by still another group of companies. The measurement, test devices, and other equipment used in the production process are made by yet other firms."

(Florida and Kenney, 1990: 78) Florida and Kenney argue that joint product developments (vertical disintegration) are born out of a production culture which may be harmful to its own existence.

> "For some this new configuration is heralded as evidence of the flexibility and renewed competitiveness of the U.S. semiconductor industry. But their optimistic spirits are dampened by the rise of large Japanese corporations who have become the main players in the low end of the customized chip business and who are squeezing the profit margins of LSI Logic and VSLI Technology, the most important U.S. producers of custom chips. An increasingly uncompetitive brand of **overspecialization**, not flexible specialization, is the distinctive feature of the U.S. semiconductor industry." (Florida and Kenney, 1990: 78)

What emerges from the Silicon Valley experience is the fact that overspecialization can prevent some kinds of innovation. The combination of small size and industrial fragmentation makes it difficult for American high-technology firms to combine one or more technologies into new hybrid innovations. 'Mechatronics'[27], 'optoelectronics'[28] and 'systems technologies'[29], are good examples of hybrid technologies (Florida and Kenney, 1990: 80). Hybrid innovations and systems technologies can be of even greater economic importance than radical new breakthrough innovations. The application of mechatronics by Japanese firms to wristwatches, for example, revolutionized the watch market, opening up a huge new market in inexpensive and reliable quartz watches (Florida and Kenney, 1990: 80 and Glasmeier, 1991). According to Florida and Kenney, the small high-tech companies of Silicon Valley and Route 128 lack the scale, resources, and long-term outlook that are needed to develop hybrid innovations and systems technologies. When companies make just one version of a product or produce just one part of a product, they have neither the breadth of in-house expertise necessary to create important hybrid innovations nor the large numbers of R&D personnel necessary to undertake a large systems innovation (Florida and Kenney, 1990: 81).

The real lesson of American high-tech structure is that small companies are great product innovators, but they have limited resources. They can initiate innovation, but few can sustain it:

> "While *Silicon Valley and Route 128* model gives rise to new, highly innovative companies at breakneck speed, it also generates a high degree of internal competition and a serious problem of industrial fragmentation. It can catalyze the world's most advanced breakthrough innovations, but it is unable to generate the small product, process, hybrid, and systems innovations that are needed to follow-through on such innovations and turn them into a wide variety of commercial products. In the end, Silicon Valley and Route 128 remain two limited enclaves of restructuring that have

> been unable to transform the main body of the U.S. economy either through the diffusion of their organizational practices or by setting in motion the 'gales of creative destruction' that can reinvigorate and renew traditional industries. Even though the present U.S. 'breakthrough' model of high-technology organization can find rich veins of technology opportunity, it is unable to mine those veins fully." (Florida and Kenney, 1990: 83-84)

Thus, the predominance of small and medium sized firms is not watertight as a more effective form of economic and technological organization. The real life experience shows that the extensive internationalization of modern capitalism has occurred alongside, and not necessarily in opposition to, the formation of industrial districts as the multinational corporation often playing a facilitating rather than a purely destructive role (Scott, 1992: 274). The decentralization of production and reliance on networks is not limited to small or new firms seeking to avoid fixed investments. Even large producers has restructured internally and externally to gain flexibility and technical advantage. For example the technopoles of Southern California dramatically exemplify the constructive role that large systems houses may play in flexible high technology production agglomerations, and the ways in which both large and small producers can co-exist in mutual but variable functional and spatial interdependence over long periods of time (Scott, 1992: 274). The Japanese success in high-tech development epitomizes also how it is possible to marry vertical organizations with innovative high-tech production.

Another characteristic of high-tech regions is that they are often associated with relatively low intensities of local input-output flows of semi-finished products, traded relations (Storper, 1995: 200). It is argued that other informal and untraded links and interdependencies are of greater importance in explaining the high-tech clustering phenomenon (Storper, 1995: 200; Keeble et al., 1997: 8) 'Untraded interdependencies' between local firms and other organizations, involving informal inter-firm networking and process of collective learning are very central to high-tech regions. These processes, which involve exchange and development of technological expertise and high rates of technological and product innovation, are seen as being based on relationships of **trust and reciprocity** (Keeble et al., 1997: 1).

Organization in innovation networks in the technology district underlines the importance of trust-based co-operation relations and non-market interdependencies in the transition process to new technological paradigms. The functioning and development of the high-tech networks implicitly presuppose a system of rules. And a high dose of trust serves as substitute for more formalized control systems (Asheim, 1997: 15). In reality, the functioning of all the networks studied relies on the establishment of relations based on trust and reciprocity: the collaboration game (Maillat et al., 1995: 257 and Fuellhart, 1999: 43). Thus, there is a deliberate attempt to reduce all contractualization as much as possible. Costly in time and money, formal contractualization is perceived as holding back innovation and becomes superfluous to the extent that the partners know one another. Consequently, it is found that the regulation which predominates in innovation networks takes the form of an agreement rather than that of contractualization (Maillat et al., 1995: 258). Moreover, 'transactions' with 'tacit' knowledge within and between networking organizations also inevitably require trust, which is easier to establish and reproduce in flat organizations than in hierarchical ones (Asheim, 1997: 14).

Last but not least in importance, high-tech production networks are highly localized. Locally and regionally defined productions systems may facilitate rich networks of information flow which have the potential to translate into competitive advantage for business organizations (Fuellhart, 1999: 43). These issues are particularly relevant to smaller firms. In Silicon Valley, Saxenian and Angel have noted the dense transactional and non-transactional relationships between firms and people that contribute to a rich and innovative environment that is conducive to providing competitive advantages in the dynamic high-technology sector (Saxenian, 1991 and Angel, 1991).

However, as Harrison have commented, intraregional relations are not entirely cohesive and extraregional linkages are of extremely high importance to Silicon Valley firms, indicating that non-local networks play a critical role even in a highly agglomerated region (Harrison, 1992 and 1994). Fuellhart also argues that although agglomeration economies are considered to have an informational component, there may be negative correlation between localized technological relations and firm performance (Fuellhart, 1999: 53). He notes that there are sign of the fact that the local environment or milieu seems to be important for the gathering of information about management and distribution strategies, whereas with respect to innovation and technology oriented information, interregional networks are more common (Fuellhart, 1999: 43). In any way, although a highly 'localized' setting does not unconditionally translate into increased access to and use of all business information sources, it does seem probable that the right locational situation can nurture enhanced information flows to and between organizations (Fuellhart, 1999: 43-53).

2.2.2. Types of High-Tech Production Networks

There exist numerous local and global links and networking arrangements between high-tech firms (Keeble et al., 1997: 9; Saxenian, 1991: 433 and Saxenian, 1990: 99-102). In general, four types of linkage can be identified for high-tech production regions (Lyons, 1995: 273): First, higher levels of locally provided routine inputs ('fixed simple linkages'); second, higher levels of globally-provided routine inputs ('flexible simple linkages'); third, higher levels of locally provided sophisticated inputs ('flexible complex linkages'); fourth, higher levels of globally-provided sophisticated inputs ('fixed complex linkages').

In terms of networking arrangements, the new post-Fordist ways of organizing industrial production can also take various forms. The specific new form of industrial organization resulting from close inter-firm networking is represented by 'quasi-integration'. Quasi-integration refers to relatively stable relationships between firms, where the principal firms (i.e. the buyers) aim at combining the benefits of vertical integration as well as vertical disintegration in their collaboration with suppliers and subcontractors (Asheim, 1997: 12). In this respect; three main types of high-tech networks can be identified (Maillat et al., 1995: 258; Echeverri-Carroll, Hunnicutt and Hansen, 1998: 722-5 and Saxenian, 1990: 95-102). The first concerns a network with a leader firm (local integrated and disintegrated asymmetric networks). The second concerns a network with a hub of firm each of which is responsible for a module (local integrated symmetric networks). Finally, the third consists of a compact network in which the overall design of the project is devised collectively without specifying or allocating given tasks (local disintegrated symmetric networks).

Innovation process with a leader firm is characterized by a certain monopoly of the leader enterprise over the innovation project. This type of networking is realized throughout strategic disintegration of production process. Strategic disintegration refers to subcontracting relations between large and small firms. Most of the large firms are networking in order to reduce their production costs but this networking is rather based on simple quantity subcontracting and generally lacks the common sense of producing together. "In this process the transactions between the prime contractor and the partners are mainly bilateral, are defined in the context of a set of specifications and give rise to the drafting of a more or less formalized contractual framework. It is thus a relatively hierarchical network-type structure in which the leader firm alone manages and supervises the innovation process." (Maillat et al., 1995: 258) Whether local asymmetric networks lead to a situation in which a large firm controls a smaller partner's strategic decisions or small firms enjoy the benefits of greater access to information by connecting themselves to a larger stock of knowledge and enhance the transfer of this knowledge by their spatial proximity is a case specific phenomenon (i.e. for different high-tech industrial districts there are different bundles of relations).

The classical example of networks with a leader firm is Japanese keiretsu system. It refers to a network of very elaborate subcontracting relationships, in which the largest firms are often only final assemblers organizing groups of smaller manufacturers (Castells and Hall, 1994: 112-113; Glasmeier and Sugiura, 1991: 395; Florida and Kenney, 1990: 72; Glasmeier and Sugiura, 1991: 400-401 and Sternberg, 1996: 535). This production system is best described as networks of firms which pass work orders to one another as specialized tasks become evident. Within a network it is possible to find an entire production process subdivided among a vast number of small firms. Thus, for many companies, success is dependent on membership in a productive manufacturing group (Glasmeier and Sugiura, 1991: 402).

Business groups, not firms themselves, are the primary unit of Japanese capitalism (Glasmeier and Sugiura, 1991: 399). Business groups can be analyzed in two different category; intermarket groups and independent groups. Intermarket groups and independent groups have distinctive traits. On the one hand intermarket groups consist of horizontally constructed networks of large firms in different economic sectors. "Firms compete across groups but not within them. ... member firms also maintain long-term subcontracting relations with small and medium size firms that are not part of keiretsu." (Glasmeier and Sugiura, 1991: 400) On the other hand, independent industrial and financial groups are webs of vertically integrated firms in one or more industrial sectors. "Each independent groups consists of a large parent company and vertically linked subordinate companies. ... Affiliate members of independent groups are more autonomous than firms linked to intermarket groups." (Glasmeier and Sugiura, 1991: 400) All intermarket and independent groups are usually organized around dominant companies, a banking institution and a trading company.

Another example of networking throughout an innovation process with a leader firm is arms-length relations of mass producers of USA and Europe. Arms-length relations differ from Japanese keiretsu system in that in the latter leader firm takes the responsibility of upgrading the technological level of subcontractor. However, in the former leader firm assumes no responsibility for this task. Even, in the former leader firm supports a jungle like competition between subcontractors in order to increase quality and profits. According to Morgan, Florida and Kenney the key feature of Japanese sub-contracting system is their problem-solving capacity. Integrated supply chain systems of the leading Japanese firms create superior results relative to the arm's length buyer-supplier relations of the West (Morgan, 1997: 494). Florida and Kenney point out this as below;

> "Hewlett-Packards' new supplier program depends mainly on punishing suppliers who deliver defective products or make late delivers. For example, when a defect is identified, all Hewlett-Packard divisions are placed on 'quality alert' and prohibited from buying the supplier until the defect is corrected and a 'correction notice' is issued. These so-called reforms stand in sharp contrast to the long-term, mutually supportive supplier relations found in Japan where large hub firms work closely with their suppliers to help them solve quality or delivery problems." (Florida and Kenney, 1990: 71)

The experience of Silicon Valley shows that large firms are ready to reject specialty and custom production in favor of standard products. "By the late 1970's, the growing threat of low-cost Japanese producers led firms such as National Semiconductor, Intel, and AMD to invest heavily in dedicated, high-volume fab-lines in order to reduce their unit costs. As they standardized products and processes to achieve high-volume output and move down the 'learning curve', they saw little need for the ongoing interaction with customers, suppliers, and competitors that had characterized specialty production." (Saxenian, 1990: 98) "*Due to this fact, they* missed a series of key technical and market opportunities *and* they began losing customers to the more responsive Japanese producers. ... Not only did the large chip-makers distance themselves from their customers, ... forced to minimize costs, they played key vendors against one another for price reductions. ... Ignoring their own genesis, the merchants initiated lawsuits against former cross-licensees, suspected imitators and employees who left to start their own firms. ... Finally, driven by the pressures of commodity production to minimize costs, Silicon Valley's merchants shifted manufacturing out of the region to lower-cost locations, both in USA and overseas. ... It appeared that only high-level research, design and prototype production would remain in high-cost Silicon Valley. ... This spatial separation of design, manufacturing, and assembly further undermined the ability of local semiconductor firms to improve products or respond rapidly to market changes." (Saxenian, 1990: 99)

In networks with a hub firm or set of firms, firms are regarded as the architects of the network. Although they have control of the project, they study its technical feasibility in collaboration with specialist partners. There is a division of skills rather than a division of labor and a modular design of the product is realized. All the partners take the responsibility of producing a specific module. It is interesting in this architecture to distinguish the center of the network from its periphery. At the center level, the transactions are multilateral and are based on a moral contract. At the center of the network, in this set-up the learning processes develop in a collective or bilateral mode (an expansion and deepening of know-how) (Maillat et al., 1995: 258).

The compact innovation network is different from the networks with a hub firm or set of firms in that there is no firm to provide central co-ordination of the innovation process. There is a collective and global concept of the innovation project. The factor which binds the partners together is the notion of a project. The contributions of the various parties cannot be evaluated a priori and cannot therefore be monitored. This approach should be regarded rather as a shared experience in which the network specifies primarily a collective work area and an exchange area. Relations can not therefore be schematized in the form of a network-type grid: the network is above all a set of partners seeking to isolate themselves so as to develop further an idea or project. The transactions are thus multilateral and governed by relations of trust and reciprocity and by a shared work ethic connected with belonging to the same milieu, the learning processes developing according to a collective dynamic. (Maillat et al., 1995: 258)

Networks with set of firms and compact innovation networks are realized throughout synergic integration of production processes in inter-firm alliances. Synergic integration is driven by agglomeration of high-technology oriented firms of generally small and medium sized. It implies a qualitative nature in networking. Long- and short-inter-firm alliances to develop joint products and new technologies, and share fabrication facilities can be listed as outcomes of synergic integration. For example in Silicon Valley although *the region's established large scale producers* came to view regional traditions of information sharing and networking as signs of immaturity rather than sources of dynamism, the 1980s start-ups, by contrast, are formalizing collaborative relationships with customers and suppliers, both within and outside of the region (Saxenian, 1990: 95). This differential perspective of these two different types of producers is also perceivable on their products. On the one hand, networks with a leader firm produce commodity products having more reliable markets and demand. On the other hand, networks with a hub firm or set of firms prefer to produce specialty high-value added products having rather a flexible demand and thus requiring more flexible production organization to be able respond the changing market conditions quickly. Interfirm alliance that is generally a characteristic of the latter group of networking arrangements can take various forms. Joint-collaborative product development, exchange of firm specific expertise and turnkey manufacturing can be given as popular examples of interfirm alliances. What follows is the analysis and illustration of each of these different forms of inter-firm alliances.

Joint product development represents the ultimate extension of interdependence in a networked system. A classical example from Silicon Valley is the Sparc (Sun's RISC chip). "*For the first time*, Sun broke with industry tradition by freely licensing the Sparc design, in contrast with Intel and Motorola's proprietary approach to their microprocessors. ... The resulting chips share a common design and software, but differ in speed and price. After supplying Sun these suppliers are free to manufacture and market their versions of Sparc to other systems producers. ... Collaboration allowed Sun to reduce significantly the cost of producing a new microprocessor. The firm spent only 25$ million developing the Sparc chip, compared to Intel's $100 million investment in its 80386 microprocessor." (Saxenian, 1991: 434) "By building a network of collaborative relationships with suppliers like Cypress, Sun has not only reduced the cost and spread the risks of developing its workstations, but has been able to bring new products with innovative features and architectures to market rapidly. ... Open standards encourage new firm entry and promote experimentation because they force firms to differentiate their products while remaining within a common industry standard. Proprietary systems, by contrast, exclude new entrants and promote closed networks and stable competitive arrangements." (Saxenian, 1991: 435)

Exchange of firm specific expertise produces mutually beneficial technological advance. A classical example is the silicon foundries of Silicon Valley. They are for the fabrication of silicon chips, or semiconductors. "Like contract manufacturers, foundries *provide* their customers *with* the cumulative experience and expertise of specialists. Unlike contract assemblers, however, silicon foundries have always been technologically sophisticated and highly capital intensive. ... This relationship can be an exchange of services with limited technical interchange, or it can offer significant opportunities for reciprocal innovation." (Saxenian, 1991: 433) Motivations of networking can be different for both sides. For example, in the case of HP-Weitek alliance to produce specialized products, Weitek is motivated by HP's more advanced fabrication process and HP is motivated by the Weitek's specialized high-quality chip designs. "The final product itself represents a significant advance over what either firm could have produced independently. Both firms see the real payoff from this alliance in expected future technology changes. ... By building a long-term relationship, the firms are creating an alliance which allows each to draw on the other's distinctive and complementary expertise to devise novel solutions to common problems." (Saxenian, 1991: 433)

Turnkey manufacturing (quality subcontracting) emerged as a result of the structural shift in functions of contract manufacturing. It was the transformation of the contract manufacturers from being only assembler or subcontractor into a part of the systems producers (Saxenian, 1991: 427 and Saxenian, 1990: 103). This is the way through which reciprocal innovation is possible to be realized. 'Board stuffing firms', undercapitalized and marginal firms which paid unskilled workers low wages to work at home or in sweatshops, were the main subcontractors of the 1970s. This profile changed fundamentally during the 1980s. There occurred a shift from consignment manufacturing, in which the customer provides components which the contract manufacturer assembles according to the customer's designs, to turnkey manufacturing in which the contract manufacturer selects and procures electronic components as well as assembling and testing the board. "*This* is a shift from a low risk, low value-added, low loyalty subcontracting strategy to a high risk, high value-added, high trust approach because the contract manufacturer takes the responsibility for the quality and functioning of a complete sub-assembly. This shift greatly increases the system firm's dependence on its contract manufacturer's process and components." (Saxenian, 1991: 431) "*But* it can take years to build the trust required for a mature turnkey relationship in which the design details of a new product are shared. ... firms which consign their manufacturing typically have six or seven suppliers which compete on the basis of cost, while those relying on turnkey contractors build close relations with only one or two firms, selected primarily for quality and responsiveness." (Saxenian, 1991: 431) According to Saxenian, these relationships can't be built over long distances and that's why the US contract manufacturing business is highly regionalised.

All interfirm alliances lead to the blurring of firm boundaries. "*However*, despite this blurring of firm boundaries both customers and suppliers make an explicit effort to avoid dependence and to preserve one another's autonomy. Most Silicon Valley companies today prefer that no customer, itself included, account for more than 20% of a supplier's output. These limits on dependence ensure that while firms benefit from collaboration in a shared goal, they do not become so tightly integrated as to loose the competitive spirit to innovate." (Saxenian, 1990: 104)

Lastly, the relationship between networks and product innovation is very interesting to note, by way of a summary, that the different types of networks correspond to specific innovation processes (Figure 3) (Maillat et al., 1995: 258; Ratti, 1991: 78-84 and Perrin, 1991: 40). The network with a leader firm will develop an innovation project concerning the addition of new elements to a product already on the market (incremental innovation which results principally in an improvement of existing things). The network with a hub firm, or hubset of firms, implements an innovation project so as to transform an existing product (adaptive innovation which involves an application to some new products and sectors of a 'radical' innovation). Finally, the compact innovation network creates a new product and its market (radical innovation which is a rare event, discontinuous in time and which opens new horizons of production and market). Collaboration with customers leads in the first instance to the step-by-step kind of changes (i.e. incremental innovations), and collaboration with partners in the horizontal dimension is more likely to lead to leap-wise changes (i.e. radical innovations) (Asheim, 1997: 12).

		Types of Networks		
		Networks with a leader firm	Networks with a hubset of firms	Compact innovation networks
Structure of relations		Local integrated and disintegrated asymmetric networks	Local integrated symmetric networks	Local disintegrated symmetric networks
Enterprise life spaces	Market space	**The strategic behavior is strongly determined by the market space (incremental innovation case)**	The market space is subordinate to the spatial division of skills logic	The market space will often have the characteristics of 'niche market' or qualified subcontract
	Production space	The production space characteristics are rather subordinate to the market space	**The strategic behavior is strongly determined by the production space (adaptive innovations)**	High qualification and integration of production space
	Supporting space	'Supporting space' is implicitly brought back to the different levels of the urban hierarchy	In the LME case, the supporting space will have a non spatial character because it is internalized. For the SME, the supporting space will be weak or subordinate	**The strategic behavior is strongly determined by the supporting space (Milieu) (radical innovations)**

* LME: Large Multinational Enterprises

Figure 3 - Types of high-tech production networks and corresponding innovation processes.
Source: Application of types of production networks developed by Maillat et al. (1995: 258) to the enterprise life spaces developed by Ratti (1991: 83).

2.2.3. Characteristics of High-Tech Firms' Intrafirm Organization

An extensive array of organizational experiments have been under way in many firms during the past decade, including delayering, team-based networks, and a new employer-employee covenant. Firstly, increased use of technologies reduced the need for traditional middle management, whose role was to supervise others and to collect, analyze, evaluate, and transmit information up and down, and across the organizational hierarchy. One of the expected benefits of flatter hierarchies (delayering) is the organization's ability to become flexible and responsive by reducing the time lag between decision and action - enabling faster response to market and competitive dynamics. Secondly, in an attempt to manage cross-unit projects and to reduce time-to-market, many firms are also increasingly relying on multi-functional, multi-unit teams. A key advantage of teams is their intrinsic flexibility.

In terms of qualitative features of firms, flexibility emerges as the general guidance to understand the structures of high tech firms. "*High-technology* firms need flexible organizational systems which can balance dialectical forces - facilitating creativity, innovation, and speed, while instilling co-ordination, focus and control, and the staying power to withstand periods of adversity." (Bahrami, 1992: 36)

"Flexibility *which is the basic characteristic of the high-tech production organization* refers to a blend of capabilities and attributes that facilitate adjustments to change. However, *it* is a polymorphous concept whose meaning varies according to the situational context. ... flexibility means 'being agile' - fast on one's feet, able to move rapidly, change course to take advantage of an opportunity or to side-step a threat. ... It also implies the ability to be 'versatile' - able to do different things and apply different capabilities depending on the needs of a particular situation. ... On the 'defensive' side of the spectrum, flexibility also refers to qualities which enable an enterprise to endure when negatively affected by change. This attribute is reflected in concepts such as 'robustness' or 'resilience'. The former characterizes the capability to absorb shocks ... The latter refers to the ability to come back from the brink of disaster without bearing permanent scars or disabilities." (Bahrami, 1992: 35)

The matrix approach which is a common organizational characteristic of innovative high-tech firms brings a functional flexibility into the organizational structure and production. According to the matrix approach, there are no grading or other formal divisions within the general scientific/technical area (Massey, Quintas and Wield, 1992: 99). Rather there existed a large pool of engineers and technicians not specifically allocated to any identified work area. For example in Cambridge where the matrix approach is employed as the main form of production organization, many establishments, including the bigger ones, had taken on elements of single status, even the biggest firms had just one canteen (Massey, Quintas and Wield, 1992: 97).

Table 9 - Organizational Dilemmas.

Control	Autonomy
Focus	Innovation
Global Products	Local Recipes
Less Duplication	Rapid Response
Time-to-Market	Future Products
Today's Performance	Long Term Vision
Managing Opposing Tensions	

Source: Bahrami, 1992: 37

Flexibility as a general guideline is also the base of understanding today's in firm organizational structures. According to Bahrami, "the key organizational challenge facing many high-technology firms is balancing several opposing tensions (Table 9): selling and servicing existing products while developing and bringing new ones on stream; remaining, disciplined, focused, and frugal, while continuously learning, experimenting, and re-calibrating; generating consensus, yet ensuring timely decisions; balancing individual contribution and teamwork; ensuring short-term profitability in the context of long-term vision. The modern high-technology enterprise needs diverse capabilities and multi-faceted organizational arrangements to flexibly deal with these complex tensions." (Bahrami, 1992: 45)

Table 10 - Organizational Attributes: A Comparison.

Traditional Model	Emerging Model
Single Center	Multiple Centers
Self Contained	Steeples of Expertise
Independent Activities	Interdependent Units
Vertically Integrated	Multiple Alliances
Uniform	Diverse Structures
Parochial Mindset	Cosmopolitan Mindset
Emphasis on Efficiency	Emphasis on Flexibility

Source: Bahrami, 1992: 46

Bahrami depicts the resulting organization specific to high-tech firms as 'a bi-modal organization' (Table 10): in that they could accommodate opposing tendencies and yet

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function as coherent and cohesive concerns. According to him, signs of bi-modality were commonly observed in broaching three types of tension: centralization versus decentralization, stability versus change, and uniformity versus diversity (Bahrami, 1992: 45).

"The resulting organization can be best characterized as both centralized and decentralized. It is centralized in that top management teams are a critical force behind charting the strategic direction and defining the boundaries for individual and team initiatives. It is decentralized in that front-line personnel can exercise discretion in dealing with new imperatives as they arise." (Bahrami, 1992: 46) Moreover, "bi-modality is also manifest in the tradeoffs made between stability and change, ... Dynamism and change are accommodated through extensive reliance on project teams, micro reorganizations, and re-development of core employees in various capacities. ... However, constant change can also be threatening and de-motivating for individuals, and disruptive and unproductive for the organization. ... many firms strive to create anchors of stability around which everything else can change." (Bahrami, 1992: 47) The third form of bi-modality is observed in teams. "*Teams* represent unity through their shared values and overarching sense of purpose. Diversity is promoted in that they have complementary skills and management styles." (Bahrami, 1992: 48)

"A critical challenge facing many business entities is how to transform their traditional organizational systems and management practices in order to become more flexible. This task requires identifying and implementing those approaches, processes, and tools that can be used to manage a bi-modal - rather than a monolithic - organization. This poses a major challenge because existing organizational systems and managerial mindsets have evolved to address uni-dimensional imperatives, rather than the new, rampant multi-dimensional tensions. ... If the experience of the high-technology sector is indicative of broader trends, the 1990s is likely to be a decade of organizational experimentation and managerial innovation, and one likely to bring forth novel organizational systems and management approaches." (Bahrami, 1992: 48)

2.3. Labor Markets

The emerging new socio-spatial system can be best characterized in terms of its spatial content by the shift of image of space from place to flow. The new communication technology has led to a different perception of space; the next century will be characterized by 'space of flows' rather than 'space of places'. This has resulted in blurring of nation state boundaries and consequently erosion of the territorial control mechanisms which is based on the spatial contiguity and hierarchy. In this new globe **learning** and **networking** is getting more and more importance and regions are being an integral part of the new socio-spatial system by employing the technological infrastructure of the new global economy which is formed through the increasing integration of telecommunications and computing. High-tech which is the source of all these developments has led to a shift in priorities considered in industrial location selection. The human capital began to get more importance with respect to natural advantages in studies concerning industrial development. The new form of advantage is competitive rather than comparative because each region has the same form of capital with varying degrees of quality which is a controllable variable by the region itself. The labor markets as being the new form of capital are at the very core of the discussions related with the new informational economy. As Porter said, the prosperity does not any more grow out from the country's natural endowments, but on the capacity of its industry to innovate and upgrade through skilled labor (Porter, 1990). Important is, that this competitive advantage is created and sustained through a highly localized process. It is certainly much easier to be competitive, if you have a possibility to get the world class work force (Jaskari, 1997).

"The relevance of conventional location theory has proven to be quite limited for understanding of the location of high technology firms and industries, primarily because location theory has long underemphasized labor as a location factor. *However*, the greatest commonality among high tech sectors is not their environment, but their use of a single variable or input, **labor**." (Malecki, 1985: 346-348) High-volume production tends to seek out favorable local labor conditions, such as low wages and little militancy. But this is not absolutely true for high-tech industrial production since it requires a high degree of well-educated and well-paid workers. "High technology industries are characterized by a greater than average dependence on skilled, professional, and technical labor, especially for the non-routine and innovative activities that are important to these industries. Professional labor, while mobile and footloose, is not ubiquitous and tends to concentrate in existing agglomerations of an industry." (Malecki, 1985: 365)

In this section it is aimed at highlighting the dynamics of labor market existing in a high-tech environment. With respect to their labor market, each high-tech region has its own peculiar characteristics which are the products of different socio-spatial processes but they have also many similarities which are the sources of their successes and points to be highlighted in this section. For this purpose, firstly, the class structure of high-tech labor markets is examined.

Secondly, employment relations and unionization in high-tech labor markets are highlighted. And lastly, the interconnections between labor mobility and innovation are explained and possible outcomes of these interconnections are given.

2.3.1. Class Structure of High-Tech Labor Markets

The first crystallized fact of high-tech labor market is that it has a dualistic structure. The nature of process of innovation which is at the core of high-tech regions necessitate a bifurcated employment structure (Massey, Quintas and Wield, 1992 and Breheny, Cheshire, and Langridge, 1985: 130). At the top of the hierarchy there is the highly educated, extremely well paid professionals and at the bottom, there is semiskilled or unskilled workers with dramatically lower wages and low benefits (Scott, 1988: 177; Storper and Walker, 1989: 169-172; Scott and Storper, 1987: 224; Malecki, 1985: 349; Harrison, 1994: 320; Saxenian, 1984: 174; Massey, Quintas and Wield, 1992: 189-191; Digiovanna, 1996: 381, 382; Castells and Hall, 1994: 60-61; Breheny, Cheshire, and Langridge, 1985: 130; Markusen, 1985a: 36-37; Lyons, 1995: 267; and Weiss, 1985: 84). This dual structure of labor market shapes also the social stratification and structuring of the urban landscape (Massey, Quintas and Wield, 1992: 85; Saxenian, 1984: 174 and Markusen, 1985a: 45-46). Planned or unplanned labor market relations affect the formation of urban landscape in such a way that there occurs geographical stratification of the residents. In the case of lack of planning, it gives rise to a host of urban problems. This is what has been experienced in Silicon Valley.

> "The marked differences in income and wealth were quickly reflected in differences in the quality of life and the availability of social services between the elite 'northern' and the working-class 'southern' reaches of the Valley, and it is only now, in the 1990's, that city planners in San Jose are making headway in installing public services, housing, and local service-sector job complexes geared to accommodating the needs of the several communities of color living in the area. ... this geographical stratification of the Valley's population gave rise to a host of problems... Housing prices in the affluent north skyrocketed, requiring the companies to come up with wage increases, subsidies and 'perks' in order to be able to attract new engineering talent. ... the rising cost and difficulty of commuting within the Valley created shortages of production workers available on a reliable, daily basis to the high-tech firms in the north. All these led to the fact that the cost of doing business within Silicon Valley rose still further. By 1980, the semiconductor and other electronics companies' solution was to shift new direct production operations to locations outside the Valley altogether." (Harrison, 1994; 321)

On this dual structure there remain a question concerning the confusion between entrepreneur and labor. This is in fact due to the fact that the class location of scientists and technologist has not been exactly defined. On this issue there is two broad thesis (Massey, Quintas and Wield, 1992: 116): On the one hand, some argues that 'increasing routinisation and de-skilling of white-collar work, including technical work, was leading to its full proletarianisation'. On the other hand, others argue that there occurred a class divide between the 'new middle class' and the working class because if technicians are 'undertaking a role of co-ordination and supervision in relation to other workers, *they* were acting on behalf of capital and could not therefore legitimately be included within the working class'.

Whatever the class location of scientists is seeing involvement in production as a low status, many scientists and technologists prefer to work in areas characterized by being distant from direct production. The middle-class disdain of physical production reinforces the feeling that engineers are significantly inferior to more respectable professions such as accountancy (Massey, Quintas and Wield, 1992:122). Consequently, this constitutes a hindrance on the use of innovative capacity created by scientist. Identifying this fact, in many countries the ways of closing the innovation gap between academe and innovation was searched out and the principle of the individual sci-tech entrepreneur was introduced into the literature in order to attract scientists to be an integral part of industrial production. But this shift towards academic credentialism is not without its critics. This has led to a sharper division between mental and manual labor.

> "Science parks were supposed to aid in bridging the gap between the academy and the commercial world. *However* their impact might rather be to tie one group of scientist-technicians within industry to the academy ... while reproducing within industry itself the correlation between status and distance from physical production." (Massey, Quintas and Wield, 1992: 162)

Thus, when the bifurcated structure of high-tech labor market is considered, the main challenge from the local and regional politicians point of view should be upgrading of employment rather than increasing it because high-tech regions epitomize and reinforce precisely a particular form of the division of labor where the possession of increased skills by some deprives others of the ability to develop their own potential (Massey, Quintas and Wield, 1992). "While in principle the development of skills by one person does not impede their development by another, in practice the requirements of the labor market may in fact introduce impediments." (Massey, Quintas and Wield, 1992) This gives rise to scarcity value. The social power of scientists and technologists has been reinforced quite simply by their very scarcity. The fundamental basis of exploitation is embedded in the social relations of production (Storper and Walker, 1989: 169-172 and Massey, Quintas and Wield, 1992: 129). More generally, the skill shortages that bid up the status and conditions of one small stratum of employees must be seen in the context of low educational and training levels for other employees.

"There are two separate issues of exclusivity. In the first place, the jobs are designed in such a way that whoever does them will need servicing by others. ... In the second place, given the current sexual division of labor in domestic work, this design of paid employment determines that it is in many cases women who will be excluded (Table 11)." (Massey, Quintas and Wield, 1992: 110)

Table 11 - Women working on Aston and Cambridge.

Category	% Female
QSEs (Quality Standard Engineers)	10
Other professional and managerial	11
Skilled manual	0
Semi-skilled manual	10
Unskilled	0
Clerical, secretarial & administrative	87
Other	6

Source: Massey, Quintas and Wield, 1992: 110.

There are other exclusions (Massey, Quintas and Wield, 1992: 111). The cleavages exist between different types of worker. The time of some workers especially of those working on the shop-floor is not flexible, but they are paid overtime. In addition to this open management is more conducive to higher-level work. Most simply the flexibility in the lives of those employed at the top level imposes constraints on the lives of others – those who service them. The privileged flexibilities of the top-level engineers and scientists are used to legitimize casualisation and insecurity elsewhere. There is no deterministic relationship between technology, labor process and organizational form, but there are clearly bundles which go more easily together (Massey, Quintas and Wield, 1992: 111-113).

2.3.2. Employment Relations and Unionization

Another basic characteristic of the high-tech region is that firms in these regions are fiercely anti-union, and have been so since the beginning (Massey, Quintas and Wield, 1992: 104-

105, 108, 113; Digiovanna, 1996: 382; Fujita, 1988: 587; Harrison, 1994; Scott, 1988: 178; Scott and Storper, 1987: 229; Scott, 1992: 269; Scott and Angel, 1988: 1054; Angel, 1991: 1512 and Weiss, 1985: 85). Bifurcated labor market is associated with increasingly segmented labor force the power of whom to resist capital has been weakened (Tickell and Peck, 1992: 196). On this issue the main question revolve around whether there is a justification for the anti-unionism. On the one hand, there is an explanation that is based on the causality between exploitation-antiunionism-high profits and gives little or no justification. On the other hand, anti-unionism is justified by identifying the causality between autonomy-antiunionism-high wages.

"According to many authors, the central feature of emerging forms of flexible production has been the withdrawal of firms from restrictive union contracts and an associated attempt to shift much of the costs of production instability from the firm to the worker, in the form of reduced job security, lower wages, and increased dependence upon part-time and temporary labor." (Angel, 1991: 1512) Angel says that attempts to unionize high-technology firms in Silicon Valley have been unsuccessful. The opportunity to reconstitute employment relations within a local market lacking a strong tradition of organized labor has attracted the many firms to Silicon Valley.

According to Angel "*employment* relation in Silicon Valley are strongly favorable to the interests of high-technology firms and to the continued expansion of semiconductor manufacturing in the region because semiconductor firms in Silicon Valley are able to draw upon a large pool of marginalised immigrant workers who lack a strong tradition of organized labor. ... With production jobs in short supply, semiconductor firms face little upward pressure on wages, and quit rates among production workers have suppressed to very low levels. The marked segmentation of professional and production workers remains a striking feature of the Silicon Valley labor market." (Angel, 1991: 1513) Thus, as Angel points out many believes that antiunionism is a way of increasing exploitation of workers and there is no or little justification for this.

On the other hand, in the British case, Massey et al. argue that "the lack of collective representation of employees was justified in terms of the level of reward and consultation the companies were capable of offering." They say that;

> "In the imagery of new work, trade unions have no place. ... One of the managers states the approach of such companies to trade unionism as following; 'No one in his company ... had a need to be in a trade union'; if a ballot of employees showed they

wanted a trade union he would be disappointed, because 'it would show we had been doing our job wrong'. *Moreover* trade unionism would be 'difficult' in a situation where most employees were of independent mind. They were all scientifically based people, wanting to do their own thing." (Massey, Quintas and Wield, 1992: 104-105)

Although Massey et al. bring some justification for anti-unionism, they implicitly point out that justifications are not large enough to legitimize the anti-unionism as a favorable arrangement for all workers. They say that job autonomy and high wages are basic justification for anti-unionism but it is restricted to only one group of workers and engineers (scientists and technicians). Really on the one hand, at the top of the hierarchy, scientific workers benefit from anti-unionism in the forms of autonomy, higher wages and 'flexible working conditions'[30] and on the other hand, at the bottom, most of the shop-floor workers suffer from anti-unionism in the forms of lower wages and security. In other words 'the privileged flexibilities of the scientific workers are used to legitimize casualisation and insecurity elsewhere' (Massey, Quintas and Wield, 1992: 113). In addition to this, if flexible work is considered as a form justification for anti-unionism, there is considerable anecdotal evidence that people overcompensate for flexible work conditions. Massey et al. explain this as; "There is a discipline ... without the need for formal controls. They don't select people who did not want to work." (Massey, Quintas and Wield, 1992: 108) Even Massey et al. argue that the absence of trade unions in high-tech industrial districts is not only an attractive feature of the company to customers but also to the government because the largest customer of high-tech products is generally the government.

Baden-Württemberg, on the other hand, illustrates that unions can be an integral part of the innovation process in industrial districts (Digiovanna, 1996: 382). "In addition to contributing to the competitiveness of Baden-Württemberg's firms, unions have also made the region's workers among the highest paid in Europe. It is important to point out the different role which unions play in the above models, because policy makers might assume that unions are detrimental, or at best irrelevant, to a successful industrial district. ... If the goal of regional development is the creation of good-paying, highly-skilled jobs, then it appears that high labor standards and strong unions are an important part of the mix." (Digiovanna, 1996: 382) According to Digiovanna, although the small firm size and frequent turnover in some industrial districts might require innovative forms of labor organizations, a high level of unionization is not inconsistent with flexibly-specialized production (Digiovanna, 1996: 382).

2.3.3. Labor Mobility and Innovation

2.3.3.1. Virtuous Cycles of Innovation and Synergy: Learning by moving

On the issue of labor mobility and the creation of innovative milieu there is two conflicting arguments. On the one hand, many argue that labor mobility support the constitution of innovative milieu and gives creative energies to the high-tech region (Garnsey, 1998: 366; Wang and Wang, 1998: 690; Angel, 1991; Saxenian, 1990: 98; Keeble et al., 1997: 2-3, 6-7; Perrin, 1991: 36; Camagni, 1991: 130; Amirahmadi and Wallace, 1995: 1757; Maillat, et al., 1994: 255; Castells, 1996: 82-83; and Steed, 1987: 262). On the other hand, some argue that high degree of labor mobility can be explained in terms of loyalty to craft but it prevents the loyalty to the locality and it is not a favorable arrangement to the economic development of the region (Florida and Kenney, 1990; and Harrison, 1994). The term 'learning-by-moving' refers to the former argument and depicts a specific form of learning different from 'learning-by-doing', 'learning-by-using', 'learning-by-interacting' and 'learning-by-searching'.

According to first group of authors innovative milieu is associated together with a high degree of labor mobility. Angel points out this as following;

> "High levels of interfirm labor mobility allow Silicon Valley firms to go beyond their own manufacturing experience and draw upon the broader stock of knowledge developed within the production complex as a whole. As workers move from one firm to another, they simultaneously help to diffuse knowledge through the Silicon Valley production complex, creating a local manufacturing environment in which firms are able to build cumulatively upon a common stock of technological successes and failures. These labor-market flows are supported by a broader set of informal contacts and collaborations among workers that, although reaching across the borders of individual firms, are concentrated within the region. The accelerated transfer of technological knowledge among Silicon Valley firms constitutes a key element of the "innovative milieu" of the production complex, enhancing the opportunities for innovation and the capabilities to pursue them."(Angel, 1991: 1509)

> "The proximity of many firms possessing complementary work requirements reduces the costs of job search and interfirm worker mobility, facilitating the free flow of workers and information through the local labor market."(Angel, 1991: 1503)

Saxenian says that innovative capacity of Silicon Valley owes much to the special characteristics of worker-entrepreneur relations dominating the high-tech production of the region. "As individuals move from firm to firm in Silicon Valley their paths overlap repeatedly: a colleague might become a customer or a competitor, today's boss could be tomorrow's subordinate. Professional respect, loyalties, and friendships transcend this turmoil. *Thus*, in Silicon Valley there is far greater loyalty to one's craft than to one's company ... A company is just a vehicle which allows you to work. If you are a circuit designer it is most important for you to do excellent work. If you can't in one firm, you will move on to another firm." (Saxenian, 1990: 97) According to Saxenian, this constitutes the main rational behind the innovative capacity of the region which as a whole benefits from an ongoing process of experimentation and collective learning as new ideas are continually recombined with existing skill, technology, know-how, and experience (Saxenian, 1990: 98).

Relationship between recruiting of labor and firms of different size is also interesting to note as it represents the importance of high degree labor mobility for the survival of the high-tech regions and their innovativeness from the point of view of small firms. Angel's study is especially very important from this point of view. He indicates that "large and small firms in Silicon Valley both require more experience of workers hired, compared with semiconductor producers located elsewhere within the USA" (Angel, 1991: 1508). He adds that within the Valley "most of the small firms are distinguished by a tendency to fill most job vacancies by hiring workers with experience form the local labor market *but* large firms, by contrast, have a greater capacity to develop labor skills in-house" (Angel, 1991: 1507).

> "In practice, the hiring of experienced engineers reflects the high costs to small firms of developing requisite engineer skills in-house. ... The heavy dependence of small firms upon experienced engineering labor increases the importance of access to the large pool of specialized engineering skills in Silicon Valley." (Angel, 1991: 1508)

Briefly, the pattern of labor-market activity observed in high-tech industrial districts is an indirect expression of local industrial structure (for example, there is a high concentration of small firms in Silicon Valley because the ability to recruit experienced workers easily from the local labor-market is one of the central advantages attracting many small semiconductor producers to the region) (Scott and Storper, 1987: 224 and Angel, 1991: 1507). Larger labor markets generate particular forms of culture and consciousness that facilitate the necessary social reproduction of the labor force. Where these facilities are publicly provided or subsidized, producers gain the advantage of deprivatization of at least part of the costs of job training and basic R&D (Scott and Storper, 1987: 224 and Lyons, 1995: 266-267).

Although labor-market processes contributes a lot to the success of high-tech regions, specific characteristic of the labor-market activity has some disadvantages because producers lose key personnel accepting job offers from competing firms (Harrison, 1994: 316;

Saxenian, 1990: 98; and Grove, 1987: 156). It is at this point that Harrison criticizes Saxenian. He says that "if computer programmers' basic loyalty is to craft, which they can effectively practice anywhere in the world, then it becomes more difficult to draw a logical connection between the organization of work and loyalties to the locality." (Harrison, 1994: 316) In other words, the labor process in high-tech regions may not be so strongly embedded. Saxenian also accepts that high rates of inter-firm mobility and new firm formation may lead to losses for individual firms. But she adds that it also fosters a dynamic process of industrial adaptation (Saxenian, 1990: 98).

2.3.3.2. Vicious Cycles of Labor Shortages and Wage Increases; Earning By Moving

One of the most serious problems in many of the successful high-tech regions is the inevitable rise of vicious cycle of labor shortages and consequently vicious cycle of wage increases (Saxenian, 1984: 187; Oakey, 1985: 103; Scott and Storper, 1987: 224-225; Grove, 1987: 156; Massey, Quintas and Wield, 1992: 194; Masser, 1990: 52 and Lyons, 1995: 266-267). The continuing higher level of shortages reinforces the bargaining power of workers and scientists and eventually results in higher salaries. Oakey argues that this is a cost of success of high-tech regions and labor shortages is a natural outcome of the innovativeness. The way of occurrence of this phenomenon in different high-tech regions is similar to each other. Grove's narration of Silicon Valley is a good illustrative of these similarities;

> "It is nearly impossible for new middle-class entrants to move into this area because the housing costs are very high. ... The net result is that, other than for single, young people and those fresh out of college, it is very difficult for middle-level professionals to move in from the outside. Therefore, businesses in the area have to make do with the middle-level professionals who were here before the housing prices skyrocketed. This, in turn, has led to the phenomenon of people constantly being lured from one company to another: perpetual job-hopping for higher pay. ... A popular joke about Silicon Valley is that all you have to do to change jobs is to turn left instead of right when you come out of your driveway."(Grove, 1987: 156)

In these and other ways, large local labor market functions as intricate mechanisms that help to sustain agglomeration economies. But local labor markets can also in certain respects have the reverse effect as they develop and grow (Scott and Storper, 1987: 224). In Cambridge and Silicon Valley (also in many of the successful and attractive high-tech regions), the problems of labor shortages interestingly arise in a 'virtuous circle' of influx of both jobs and people (Massey, Quintas and Wield, 1992, Saxenian, 1984 and Oakey, 1985). *"Companies continue* to go to the area because the very size of the high-tech labor market holds out the

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promise that any individual enterprise will be able to acquire the labor it needs even in a wider context of overall shortage in the area. ... the shortage and the bargaining power of these workers puts up costs to the companies through location costs as well as more directly through salaries." (Massey, Quintas and Wield, 1992: 194)

Oakey, Saxenian and Massey et al. argue that there is a strong correlation between the degree of innovativeness of a region and the degree of attractiveness and labor problems. Types of labor shortages are not the same in each high-tech region. On the one hand, more innovative and attractive regions suffer from a shortage of shop-floor workers (Oakey, 1985; Saxenian, 1984: 187 and Massey, Quintas and Wield, 1992). On the other hand, the main form of labor shortage in less innovative high-tech regions is reported as research and development personnel (Oakey, 1985 and Massey, Quintas and Wield, 1992). Oakey points out this as below;

> "Significantly, there was difference in the types of labor shortage in Scotland compared with the other regions. ... research and development personnel constituted the main category of shortage in Scotland, while shop-floor skilled workers constituted the main category of shortage in more prosperous South East England and *Silicon Valley*. ... Firm executives were questioned, ... evidence is that labor was less of an inhibitor of product innovation in the Scottish instance compared with the South East England and *Silicon Valley* firms."(Oakey, 1985: 103-104)

"According to local semiconductor producers, their operations in Silicon Valley were seriously threatened by two problems. First the inflated price of housing had undermined their ability to attract the professionals who are crucial to their operations. ... Second, all suffered from a shortage of production workers and high turnover rates among their production work forces which they attributed to the lack of affordable housing and the increasingly long expensive commutes to work." (Saxenian, 1984: 186) "The initial response of local firms *to the problem of the lack of affordable housing and the increasingly long expensive commutes to work* was to raise wages, salaries, and benefits. ... A few companies even began to provide bus tickets or van pool services for their workers. Relocation, however, soon emerged as the preferred long run solution for these companies. ... by 1980 Silicon Valley's largest semiconductor and electronics companies had started to expand their advanced manufacturing operations in distant locations." (Saxenian, 1984: 187)

2.4. Conclusion

Rather than a several-stage innovation process beginning with an academic or research idea, which is gradually transformed into finished new goods, the new conception of innovation requires the integration of all skills (marketing, design, production and R&D) at all stages of the process. Comparing with modern innovation theory, the linear model of innovation does not fit such new forms of industrial innovation. Interactive models of modern innovation theory rely on spontaneous forms of reciprocity which can be realized only through synergic interactions established on the base of mutual-trust relations.

Innovation systems existing in a high-tech environment can be grouped into two different categories which also corresponds to two different models of innovation. The first concerns the regionalised national innovation system in which parts of the regional production structure and institutional infrastructure in a region functionally belong to the national innovation system (technopoles or science parks that are often implemented into the region in a *top-down* way). And the second concerns the regionally embedded innovation system in which both the regional production structure and institutional infrastructure are embedded and established in the region in a bottom-up way. The former corresponds to linear model of innovation and the latter corresponds to interactive models of innovation.

Innovative high-tech production is characterized by the predominance of small and medium sized firms and requires a horizontal specialization or complementary in products. However, world experience also shows that it is possible to integrate innovative high-tech production strategies into vertical organizational structure. The decentralization of production and reliance on network is not limited to small firms. Even large producers have restructured internally to gain flexibility and technological advantage.

Horizontal fragmentation of high-tech production makes it possible for small and medium sized firms to generate breakthrough innovations but it can't replace the strategic planning which is achieved by the management of a vertically integrated firm. Thus, while networks can and do promote innovation within existing technological framework, horizontal networks of atomic firms can prevent technological upgrading and the mining of rich veins of newly opened technological opportunities.

High-tech production is associated with relatively low intensities of classical input-output flows. Informal and untraded links between local firms constitute the core of relations occurring in a high-tech environment. There is a deliberate attempt to reduce all contractualization as much as possible. The realization of sharing knowledge and expertise is realized throughout transfer of tacit codes of information. And transaction with tacit knowledge between networking firms requires trust and flatter organizational structures. It is the local labor market through which tacit codes of knowledge diffuse within the high-tech region. Thus, local networking through staff mobility is particularly important in the high-tech regions.

High-tech inter-firm networking is represented by quasi-integration which refers to relatively stable relationships between firms. Employing quasi-integration firms combines the benefits of vertical integration and disintegration. Three main different form of quasi-integration can be identified: First concerns a network with a leader firm which exercises a monopoly over the innovation project and other firms; second concerns a network with a hub of firm each of which is explicitly responsible for a module; and third consists of a compact network in which the overall project is implicitly and collectively realized. Inter-firm alliances emerge as the common form of interacting for the last two form of quasi-integration. Inter-firm alliances can take various forms (joint-collaborative product development, exchange of firm specific expertise, turnkey manufacturing and so on).

Briefly, two different forms of motivation can be identified for firms networking in high-tech production. On the one hand, predominantly large firms are generally networking with small and medium sized subcontractor firms in order to reduce their production costs but this networking is rather based on a simple subcontracting relation with a lack of sharing a common sense of producing together. On the other hand, predominantly small firms are generally networking by collaborating in order to respond the fast changing market conditions. It is rather the latter form of motivation and interaction which characterize the innovative high-tech production.

High-tech firms' intrafirm organization exhibits a bi-modal structure. A bi-modal organization can accommodate opposing tendencies and yet function as coherent and cohesive concerns. *High-technology* firms need flexible organizational systems which can balance dialectical forces - facilitating creativity, innovation, and speed, while instilling co-ordination, focus and control, and the staying power to withstand periods of adversity.

High-tech labor market is highly segmented because the nature of the work done necessitate a privileged part of the workforce to exercise the initiative and imagination, and mass of the workforce to be passive adapters. In this way the possession of increased skills by some deprives others of the ability to develop their own potential. Most simply the flexibility in the lives of those employed at the top level imposes constraints on the lives of others – those who service them. The privileged flexibilities of the top-level engineers and scientists are used to legitimize casualisation and insecurity elsewhere.

In principle the development of skills by one person does not impede their development by another but in practice the requirements of the labor market may in fact introduce impediments. The social power of scientists and technologists has been reinforced quite simply by their very scarcity. Despite the high levels of unemployment locally, skills shortages can be reported in engineering trades and new technology trades. The image of the high-tech region as the source of innovation attracts many entrepreneurs to the area by creating vicious cycle of skill shortages. The inevitable consequence of this is the increasing wages because the continuing higher level of shortages reinforces the bargaining power of workers and scientists and eventually results in higher salaries. This gives rise to higher labor turnovers.

Producers lose key personnel accepting job offers from competing firms. In this way skill shortages increase the labor mobility and gives birth to the constitution of innovative milieu. Thus, the diffusion and survival of prescriptive knowledge depends upon the existence of high degree of labor mobility. However loyalty to craft which justifies the high labor mobility can result in decreasing bargaining power of the high-tech region against the other regions because loyalty to craft intrinsically prevents the loyalty to locality. Thus, on the one hand, some argues that innovative capacity of high-tech labor market is based on its autonomy and flexibility in relation to its ability to exercise what he or she wants to do. On the other hand, others argue that although loyalty to craft gives rise to innovative synergies, it also facilitates the transfer of innovation to competing localities. Whatever the result is in available large local labor market, firms can adopt more flexible labor turnover policies and externalize to a relatively high degree their labor market relations. These possibilities allow them in turn to respond more effectively to economic fluctuations and uncertainties. Firms in small labor markets, by contrast, are evidently more prone to hoard their workers because of the greater difficulty of finding replacements for vacancies when needed.

From the regional planners point of view, a restructuring of regional policy is necessary in order to accommodate high-tech industries and to design policies that correlate with the industrial objective of competitive advantage. In this restructuring the main difficulty is with the realization of structural characteristics of high-tech industrial districts. For example, creation of innovative capacity naturally necessitates a fragmented labor market with low degrees of loyalty to the locality. But this creates the greatest dilemma of high-tech regions for the strategies and policies to be defined from the point of view of labor market. A local consciousness is necessary to create platforms of discussion in order to constitute common and shared challenges.

CHAPTER 3

REGULATION MECHANISMS OF HIGH-TECH INDUSTRIAL DISTRICTS

3.1. Models of Regulation Mechanisms

World experience of high-tech development reveals that the state constantly intervenes in technological development, in various ways and with varying degrees of success. The models range from the command economy of the former Soviet Union through to the many and varied cases in which a capitalist state enters into relationships - sometimes with procurements, sometimes as strategic coordinator, sometimes a mixture of these two - with private corporations (Castells and Hall, 1994). In the absence of planning and central control, outcomes result from processes of self-organization which involve collective learning. In anyway, sustainable growth requires economic and institutional 'selection processes' that allocate investment resources to innovative developments through institutional innovation and policy initiative. In general regulation systems relating to high-tech development can be grouped into three groups. First group covers high regulation systems which are characterized by the dominance of command state model. Second group covers intermediate regulation systems which employ developmental and/or corporatist state models as the dominant regulation mechanism. Third group covers low regulation systems which make use of entrepreneurial state model. The matching of regulatory frameworks with different types of high-tech development is presented in Table 12.

And Table 13 shows the general comparison of regulation mechanisms prevailing in high-tech regions. The limitations of this comparison should be considered in relation to the fact that categories and types drawn here are transitional rather than strictly defined ones. Although relatively distinct, these archetypes may overlap and a regulation mechanism may contain elements of more than one model. The typology should therefore be viewed largely as a vehicle illustrating the focus of activities and the major mechanisms contributing to developing a high-tech industrial district and building a region's comparative advantage.

Table 12 - The matching of regulatory frameworks with different types of high-tech development.

Type of high-tech development	*Planned occurrences*	*Mixture of two extremes (Planned and Spontaneous)*	*Spontaneous growth*
Matching regulatory framework	*Command State Model(Dominance of Public Sector Activity)*	*Corporatist and Developmental State Models (Interplay of Public and Private Sector Activity)*	*Entrepreneurial State Model (Dominance of Private Sector Activity)*

Table 13 - Comparison of Regulation Mechanisms

Regulation Mechanism	High-Tech Regions	Local Univer-sities	State-provincial and local government policies	Federal government institutions and programs (R&D included)	Private sector activity - spin-off, venture-capital
Command State Model (Dominance of Public Sector Activity)	Akademgorodok, Swiss Jura Arc (early phase of development)	● ○	○ ●	●	○
Developmental State Model (Interplay of Public and Private Sector Activity with Relative Dominance of Public Sector Involvement)	Hsinchu, Taedok, Tsukuba, Kansai and Kumi Ind. Dis.	●	◑	●	◑
	Technopolis Program and Beijing Ind. Dist.	●	●	◑	◑
Corporatist State Model (Interplay of Public and Private Sector Activity with Relative Dominance of Private Sector Involvement)	UK Science Parks, Silicon Glen, ICs, Silicon Riviera	●	● ◑	◑ ●	●
	Jæren, Swiss Jura Arc	◑	◑ ●	● ◑	●
Entrepreneurial State Model (Dominance of Private Sector Activity)	Silicon Valley, Route 128, Hertfordshire	●	○	◑	●
	M4 Corridor, Silicon Valley North	◑	○	●	●

● Critical, ◑ Very important, ○ Important.

3.1.1. High Regulation Systems: Command State Model

In command state model, government directly intervenes in the system and regulates everything in a detailed context. Private firms are subject to strict rules of regulation and they can not determine their fate independently. In both creating and sustaining a high-tech region, command state model requires a strong involvement of government policies. Although theoretically it includes the necessary elements of magic formula of the high-tech development, the real life experience (Akademgorodok and early development of Swiss Jura Arc) shows that absolute dominance and/or control of public sector activity over the high-tech development can lead to the inevitable rise of sclerotic milieux. High degree of bureaucracy prevents the real synergy and leads to a waste of scarce resources. It is the real lesson of Akademgorodok and Swiss Jura Arc that high-regulation systems prevent real synergy occurring through networking. Akademgorodok as a top-down initiative and Swiss Jura Arc Cartel as a bottom-up initiative illustrates the point that the shifts in technological paradigms requires a more flexible system of governance of high-tech industrial production in order to be successful.

The quality of the research institutes in Akademgorodok was very high, simply because of the quality of the scientists who went to work there. But little added value resulted from the spatial proximity between the institutes, as they rarely related to each other (Castells and Hall, 1994: 56-57). At the original plan there was no industrial zone in Akademgorodok because the purpose of the plan was to preserve the social integrity of Akademgorodok as a scientific community, separated from the industrial working-class city of Novosibirsk (Castells and Hall, 1994: 44-45). "The isolation of the Akademgorodok institutes from industrial firms was such that each major institute had its own industrial shop (actually a factory) in Akademgorodok, to produce the machinery it needed for its experiments" (Castells and Hall, 1994: 48-49). "This also created great hostility on the part of the local authority which always saw Akademgorodok as an artificial implant, siphoning Moscow funds for the gratification of a useless intelligentsia" (Castells and Hall, 1994: 44-45). As a result, Akademgorodok became increasingly provincial and isolated.

The early history of the Swiss Jura Arc is also illustrative how a high-regulation system fails to comfort the real success. "Beginning in the late 1920s the Swiss watch industry organized as a cartel to reduce the opportunistic behavior of industry participants.[31] The resulting structure, though highly efficient and profitable, outlived its usefulness.[32] Faced with the need to shift from a technology based on mechanics to one based on electronics, a time lag built into the fragmented system inhibited rapid information flow. Shifting technological systems required that institutions and other critical components of the existing system be substantially modified. But this task proved difficult. Initially, the region did not have the training capacity to provide electronics engineers. These skilled workers had to be imported from outside. The watch industry's collective research efforts to pioneer new technology could not overcome organizational inertia. Since no single firm could be the 'first' to introduce the collectively developed innovation, each firm had to develop its own. Longstanding inefficiencies embedded in the production system led many firms into bankruptcy, resulting in bank ownership of some of the region's most famous and successful firms." (Glasmeier, 1991: 482)

Glasmeier argues that (1991) it is the technological discontinuities that led to the declining of Swiss Watch industry because of the inherent characteristics of network relations built in industry through cartel. There is also a reverse argument which focus on the recent success of Swatch and favor the progressive effects of network type organizations in production. Maillat et al. (1995) argues that a certain continuity is observable from the watchmaking tradition to current forms of microtechnological know-how. According to them, the know-how engineers acquired while working on the development of the electronic watch enabled them to re-train and, frequently, to set up their own microtechnology firm in the region. The redeployment of these engineers contributed largely to the development of microtechnologies. "This continuity has not, however, been achieved smoothly and along a linear trajectory. In reality, it is more accurate to speak about a process of breaking-affiliation." (Maillat et al., 1995: 254) According to Maillat et al. (1995: 252) what happened in Swiss Jura Arc is a qualitative process of change understood as a process of creative destruction in Schumpeter's sense.

3.1.2. Intermediate Regulation Systems

3.1.2.1. Developmental State Model

The distinction between two types of regional planning, adaptive (passive) and developmental (active) planning, helps to clarify the concept of 'developmental state'. "Adaptive planning is based primarily on the recognition of the impact of the general trends of development on the spatial system. *Thus, much attention is given* to physical planning and the allocation of public investments on the basis of needs rather than on the basis of developmental potential considerations." (Hermansen, 1975: 292-293) "*On the other hand,* developmental planning is based on the recognition of the interplay and feedback relations between economic development and spatial evolution *and* seeks to identify and achieve within a dynamic and historical context a pattern of evolution of the spatial structure that at any point in time is judged to be the most efficient from the point of view of promoting a sustained process of rapid economic development." (Hermansen, 1975:293) "In contrast to adaptive planning, developmental planning assumes a great number of degrees of freedom for intervention in the spontaneously generated evolution in the spatial system, to correct it, to extend its linkages in space, and to induce entirely new trends through the development of localized growth poles." (Hermansen, 1975:293-294) Developmental planning can be defined as the intervening in the interplay of economic development and spatial evolution, aiming at controlling the process and steering the evolution of the spatial organization into a structure which is judged to be more conducive to the resolution of the real problems of national development than the one which would arise out of adapting them to the prevailing trends." "Shortly, the task of developmental spatial planning can be outlined as that of intervening in the spontaneously generated evolution of the spatial organization in order to control and direct it by the implantation of strategically located growth poles and growth centers." (Hermansen, 1975:354)

Most of the experience of developmental planning aiming at the high-tech industrial district creation is characterized as being successful attempts. Successful planned occurrences are particularly evident in the case of the so-called developmental state, which is so characteristic of Japan (Tsukuba Science City) and of the other East Asian tigers (Taiwan (Hinchui Science City) and Republic of Korea (Taedok Science Town)). But in different measure they are also typical of many advanced countries, where national governments back high-technology projects for reasons either of national defense or of national prestige.

Conceptually, Tsukuba first originated in the 1958 Tokyo metropolitan area development plan - a London-style regional planning exercise - as a satellite science city for Tokyo (Castells and Hall, 1994: 68-69). The project involving the construction of a new town with a strong research and development dimension began in 1963 (Masser, 1990: 46). A major university was relocated from the Tokyo area to provide the academic nucleus for the new town and a large number of the government's major research and development institutes have been rehoused in the city (Masser, 1990: 46 and Castells and Hall, 1994: 70-71). It was 1970 when the science city was founded about 70 km to the north east of Tokyo (Stöhr and Pönighaus, 1992: 606). Briefly, Tsukuba Science City can be considered a **centralized** technopolis at the national level (Stöhr and Pönighaus, 1992: 606).

To decentralize researchers and R&D specialists was not easy because unlike most sites chosen for the later technopolis program, *an entire university was moved out of Tokyo to Tsukuba*. Scientists and researchers working in the science city still live in Tokyo and other cities, and commute to Tsukuba City where there are no social or cultural facilities (Fujita, 1988: 589). Thus at the beginning there was a great deal of opposition to moving out of Tokyo, both from the laboratories and from the Tokyo Teachers' College (Castells and Hall, 1994: 70-71). But a major change occurred after 1985, when the International Science and Technology Exposition was held in Tsukuba; private firms wanted to locate within a maximum one-hour travel time from Tokyo without serious delays, and so were encouraged by the infrastructure improvements - particularly, the new expressway - made for the exhibition (Castells and Hall, 1994: 70-71). The trend has been accelerated by the Law of Promotion of Research Exchange, approved in December 1987, which allows private enterprises to use the facilities of the national institutes, and promotes personnel exchange and joint ownership of patents between national institutes and private enterprises (Castells and Hall, 1994: 70-71). At the university, the International Science Foundation was established by the Ministry of Education to help develop industry/academic relationships, though there remains the problem of how far high-tech industry can be attracted (Castells and Hall, 1994: 72-73).

In addition to these, "a special Tsukuba Research Support Center has been built by a joint public-private consortium; it aims to provide core facilities for open laboratories and research exchange, together with 'incubators' for start-up firms, exhibition halls, information services, and in-house programs. The idea is that it can achieve services for its members that otherwise would be beyond the capacity of any of them. Established in 1978, the Center first worked to develop meeting places and then the means of exchange, for instance posters announcing meetings, and a computer network for a database, electronic mail and bulletin board." (Castells and Hall, 1994: 72-73) Moreover it can offer specialized services such as materials analysis, worldwide patent information, and seminars featuring leading technological developments in its members' fields and it manages living quarters for foreign researchers (Castells and Hall, 1994: 74-75). With the exception of the government's dramatic development of Tsukuba Science City, research and development, corporate headquarters and government functions have remained concentrated in and around the Tokyo-Osaka region (Glasmeier and Sugiura, 1991: 408).

In Korea the shift from light industries to heavy industry, then to high-technology manufacturing, was planned by the government and executed by large Korean conglomerates (*the Chaebol*) whose formation and orientation had been decisively shaped by the State (Castells and Hall, 1994: 58-59; Park and Markusen, 1995: 87-88) "Access to finance, tax incentives, import controls, export promotion policies, and training subsidies have been used to shape capacity. The expansion of industrial exports has been the central objective, and the strategy was fashioned to promote the most promising industries at any given stage." (Park and Markusen, 1995: 87) "Although a regional development policy existed on paper, aiming at decentralization of economic activity and regional balance, the instruments (locational directives and incentives) for its enforcement were all too weak." (Castells and Hall, 1994: 58-59) "The use of locational directives and incentives were only successful in dispersing heavy industries such as steel, automobiles, and chemicals from Seul but they have been less successful in the most recent era of high-tech production." (Park and Markusen, 1995: 88)

"The Government was aware of the need for regional decentralization particularly in the context of acute regional rivalry in South Korean politics. Thus, given the symbolic value of R&D facilities, in the early 1970s President Park himself took the decision to propose a new science town to be built in central South Korea, on an undeveloped site in the heart of the country: Taedok Science Town was born." (Castells and Hall, 1994: 58-59) "Taedok was conceived and implemented as a pure-science town entirely devoted to research institutions, supported by scientific and engineering universities. *47 Out of the 104 universities and colleges existing in South Korea was moved to Taedok.* The intended linkage with private firms was to be established through the research organizations of the private sector." (Castells and Hall, 1994: 61)

"There is no manufacturing or agricultural activity in Taedok; and there is absolutely no connection between the research activities in the town and the productive activities in the area around it, particularly in Taejon, a relatively industrialized city." (Castells and Hall, 1994: 60-61) "In addition to this the institutes have minimal contact with each other, and they all report that they could conduct their activity anywhere; they get no benefit in interaction or synergy from their location in Taedok. Thus it seems that Taedok is a pure manifestation of an all-powerful government's will to relocate those institutions over which it has direct or indirect power, and which can be relocated without major harm to their scientific output." (Castells and Hall, 1994: 62-63) "In this context, the Taedok project appears as a purely political decision." (Castells and Hall, 1994: 62-63) The real lesson of Taedok is that "in some instances, the fact of moving the research units from their original networks may hamper the quality of the research, by increasing their isolation vis-a-vis national and international scientific milieux." (Castells and Hall, 1994: 81) "In addition to this, the more a technopole is based on public research institutes, the more it is difficult to link up with industrial applications that make the research economically useful." (Castells and Hall, 1994: 82-83)

Hinchui Science City of Taiwan is especially illustrative how a latecomer country into the high-tech scene succeeded to integrate high-tech into its economic development by creating a cooperative learning atmosphere. Compared with the planned developments of Tsukuba Science City in Japan and Taedok Science Town in Korea, the development of Hsinchu Science City in Taiwan demonstrates some unique experiences in that the government-led projects in the production-oriented technology park (Hsinchu Science-based Industrial Park, HSIP) have successfully stimulated national and local economic development but failed in promoting the physical development needed in the context of a technopolis (Lin, 1997: 257). The Park was not conceived as an instrument of local economic development at all, but as a national Government demonstration project to foster the so-called 'co-operation triangle' between government research institutes, universities, and private high-technology firms, under the auspices of the Ministry of Kaohsig (Castells and Hall, 1994: 100-101). Although regional development was not a primary motivation for establishing HSIP in the beginning, its continuous economic prosperity has eventually trickled impacts down upon technopolis development, although slowly (Lin, 1997: 265).

Hsinchu epitomizes Taiwan's drive to develop high-technology manufacturing (Castells and Hall, 1994: 108-109). In spite of its limited importance in the broader context of the island's industrial development, the building of an industrial complex on the basis of a government program, and of government-established research institutions, shows the direct connection between development policies and the new industrialization process (Castells and Hall, 1994: 108-109). While most technology parks are purely private sector real estate investments in western countries, Hsinchu is a purely government-led project planned and established by the National Science Council at the central government level, which started operating in December 1980 (Lin, 1997: 259). By developing forward and backward linkages in the Park, private firms have *also* contributed decisively to economic growth and technological upgrading (Castells and Hall, 1994: 108-109). Where necessary, the Government also directly enters into industrial production, establishing joint venture companies with private capital (Castells and Hall, 1994: 102-103)[33].

Castells and Hall argue that the government impact over the firms is very impressive. According to them the reason why firms choose to settle down in HSIP is just to please the

Government (Castells and Hall, 1994: 104-105). While much of what happened in Hsinchu could have happened in Taipei, the fact is that a government-initiated project became an entrepreneurial industrial center, successfully supported by some of the most advanced technological centers in Taiwan. It was on the basis of such development-oriented policies that Taiwan modernized and upgraded its industrial structure to become an aggressive competitor in high-technology trade in international markets. (Castells and Hall, 1994: 108-109)

3.1.2.2. Corporatist State Model

The European and USA experience of constituting high-tech industrial districts is generally characterized as being the products of corporatist state structure. In contrast to developmental state, corporatist state is liberal rather than interventionist in character. Regional and urban policy *should not be considered as being* practiced separately from some of the other national policies which have played an active role in the spatial shaping of high-tech development activities. Education and science policy in Britain, and defense spending in the United States, are two such policy areas (Hall and Markusen, 1985a: 150 and Premus, 1988: 442).

Though America and most of the European countries have had no specific regional policy like Japan's Technopolis Program, they have had a set of urban policy initiatives (Hall and Markusen, 1985a: 148). Science Parks of USA and UK, the Network Programme of Denmark, Sophia Antipolis, Innovation Centers of Germany and Jæren can be considered as the products of corporatist state structure. In the USA and partly also in the UK, military base location, government research and development funding, and defense procurement practices appear to have constituted the real industrial-regional policy (Hall and Markusen, 1985a: 148).

"With the creation of the National Science Foundation (NSF) in 1950, the US government has taken an active role in fostering a climate for technological innovation. The belief that Federal support for basic research (primarily at universities) will lead to the application of new fundamental knowledge in industry and government is the cornerstone of US science policy." (Premus, 1988: 442) "The NSF Cooperative Research Program has spawned over twenty applied-research centers on US university campuses since 1973. These centers receive financial and technical support from the NSF and are expected to become self-sufficient within five years." (Premus, 1988: 442) "The primary mission of the NSF centers is to develop generic technologies of interest to a wide variety of firms within a broadly defined industry. The availability of generic technologies and supportive research is intended to act as a lure to private industry. NSF anticipates withdrawing its funding support as the centers attract industrial sponsors." Premus, 1988: 442

"Besides the NSF centers, Federal agencies, such as the Department of Defense (DOD), have been forging closer research ties with universities. The University of Maryland and the University of Illinois have been designed as DOD centers for research on the development of the supercomputer. The purpose of these and other agency-funded research centers is to develop technologies and computer software to support the agency's mission, but, because of possible spin-off effects, these Government-university alliances have the effect of luring industry to the regions in which the universities are located." (Premus, 1988: 442) "The Small Business Innovation Research Act of 1981 requires Federal agencies to set aside up to 1.25% of their R&D contracts for small businesses. These actions have spurred small-business interest in Federal R&D contracts and they have spawned the growth of patent offices on US university campuses." (Premus, 1988: 442) The proper role of central government is to nurture the climate for technological innovation and maintain strong support for basic research (Premus, 1988: 443). "It is primarily at the state and local level that centers of engineering excellence, venture capital funds, incubators, science parks, improved university environments, and efforts to improve the education system receive much of their support." (Premus, 1988: 447)

In the UK, science parks developed as a 1980s attempt, using a US approach, to bridge the gap between academe and innovation (Massey, Quintas and Wield, 1992: 72). But historically, it goes back to 1960s: It was Harold Wilson, then Prime Minister, who started the ball rolling by discussing science parks after a visit to the USA in the second half of the 1960s; and by the early 1970s the first two had begun to get under way. They differ from most previous attempts, since they invoke the principle of the individual sci-tech entrepreneur as bridging agent rather than innovation by large vertically integrated industrial corporations (Massey, Quintas and Wield, 1992: 72). Behind the Science Park policy of UK there is the argument that universities have many brilliant people making new discoveries and fundamental inventions but that they lack the means or the will to reach out to the market (Massey, Quintas and Wield, 1992: 56). Science parks were supposed to aid in bridging the gap between the academy and the commercial world (Massey, Quintas and Wield, 1992: 162). Universities were called to reorient their work more closely to the needs of industry because university knowledge is very general and firms require specific solutions to immediate problems (Massey, Quintas and Wield, 1992: 75). But there was concern, even from industrial companies, that the shift further than this along the road to commercial, and thus market-oriented and necessarily shorter-term perspectives, may have negative longer-term effects on British universities' basic research (Massey, Quintas and Wield, 1992: 75).

The governance structure of science parks is illustrative of how local governments can be involved in technological development. There exist a corporatist interest mediation between the local actors involved in the creation of the science park. Generally City Council (1), Local University (2) and Local Banks-Foundations (3) are the three actors involved in science park formation. Central government's intervention is generally considered to be low. Sometimes it is the formation of a development agency which is responsible for the creation of research oriented park. Heriot-Watt Research Park, which is known as Silicon Glen, is the product of this kind of a development (Massey, Quintas and Wield, 1992: 201-202)

"*In the case of Sophia-Antipolis,* a local syndicate, SYMIVAL, was set up in 1975 to represent five local communes. ... It began to develop the infrastructure and to delegate powers of commercial development. In 1977, the public sector entered the stage and the park took off. The enterprise was powerfully assisted, at this time, by the creation of a semi-public company to try to draw foreign investment outside the Paris area. In 1982, François Mitterrand's administrative reforms gave more power to the local department of Alpes-Maritimes, which has general administrative responsibility for the site and is partly responsible for management through a semi-public management company, SIAM. The Contrat de Plan for the 1984-8 four-year plan at last recognized Sophia-Antipolis as an element of regional development; but still rather as part of a policy of deconcentration of public enterprises and services to a 'French Sunbelt' than as part of a truly synergistic development process." (Castells and Hall, 1994: 86-87) The notion of developing 'technopoles' on the model of Sophia-Antipolis became suddenly very attractive, resulting in more than 40 developments of this character during the 1980s. Of late years, French regional policy-makers have started to play a particularly active role in the development of national technopoles. Much of this role has focused on attempts to stimulate agglomeration economies in selected areas through publicly funded CRITTs (i.e. regional technology innovation and transfer centers) and generous subsidies to innovative firms (Scott, 1988: 180).

"Since the beginning of the 1980s, the establishment of innovation centers has been *also* one of the most popular instruments for local and regional technology policy in Germany.

Following the founding of the first innovation center - the Berlin Innovation Center - in 1983, around 200 municipalities have established similar facilities." (Tamásy, 1999: 1) Innovation centers are in fact property-based initiatives which have been introduced in Germany focusing on the needs of technology-based start-ups. However, not all of these property-based initiatives can be regarded as innovation centers as content and packaging can substantially differ (Tamásy, 1999: 2). "In most German regions the potential of young, innovative firms is too small and, in total, decreasing, which fails to promote the sustainable success of innovation centers. From a national, regional and local perspective the number of innovation centers in Germany is too high to fully utilize all the facilities with respect to target groups." (Tamásy, 1999: 4) At several locations the innovation centers have already been closed. In Germany innovation centers are primarily supported and built by using public funds (Tamásy, 1999: 2). Occupancy of firms in innovation centers is limited to a short time period. In addition, there is minimal participation of universities. It is generally municipalities that support establishment of innovation centers.

"Although much smaller than other industrial districts, one of the best examples of a high-tech industrial district *characterized by predominance of corporate state structure* in Norway is Jæren where an organization called TESA (Technical Cooperation) was established by local industry in 1957 with the aim of supporting technological development among the member firms, which were small and medium-sized, export-oriented firms producing mainly farm-machinery. This has, among other things, resulted in the district today being the center for industrial robot technology in Norway with a competence within industrial electronics/microelectronics which is far above the general level in Norway." (Asheim, 1997: 19) "As part of the work to promote the member firms competitive advantage, TESA took active part in the establishment of JÆRTEK (Jæren's Technology Center) in 1987. The aim of JÆRTEK is to offer training preparing workers and pupils in technical schools for the advanced industrial work of tomorrow, and to secure the competence basis for a continued, rapid technological development." (Asheim, 1997: 20) The collaboration within TESA is on process innovation and not on product innovation. This factor strengthens the qualitative dimension of cooperation by stressing technological development of common interest to all participating firms.

3.1.2.3. State Monopoly Capitalism

In Japan a hybrid model of governing industrial production and technological development is developed by the interplay of developmental and corporatist state models. Although the general structure of regulation system of Japanese technological and industrial development matches more properly with the developmental state model, Japan is not, and never has been, an ordinary market capitalist state. Its economic system can more accurately be described by a term that Japanese economists use: **state monopoly capitalism**, planned and directed by bureaucrats in an extraordinarily close association with the big conglomerate corporations that dominate the Japanese economy (Castells and Hall, 1994: 112-113). It is a new kind of planned economy. While the Japanese political and administrative system favors minimum intervention in the economy, and while planning in Japan is more loosely-structured and open-ended in character than comparative practices in western countries, Japan does appear to have both a comprehensive and effective statutory (lawful) system for regional development planning (Abe and Alden, 1988: 437).

The term 'Japan Inc', in Japan often called the 'third sector' (a co-operation of local government, local business and local universities), refers to this hybrid model of governing industrial production and technological development. Third sector, which combines the elements of corporatist and developmental state models, involves a policy framework to stimulate local effort by developing a strong 'do-it-yourself' dimension to economic development (Masser, 1990: 51).

The corporatist structure of Japanese high-tech industrial development and governance also shows some deviations from the European experience where labor is represented in economic policy-making (Fujita, 1988: 586). In Japan collective bargaining remained weak for company-based unions. National centers of labor federations were divided and remained ineffective in industrial policy-making in the state apparatus (Fujita, 1988: 582). In the Japanese state's case, the corporatist structure does not include organized labor *but* this absence in industrial policy-making in Japan does not mean that the Japanese state is not also a corporatist state structure *because* the Japanese state simply uses another device to modify and mediate class struggles instead of incorporating labor in the state apparatus (Fujita, 1988: 586). This Japanese device could be called 'welfare corporatism'. The state has continued to rely on the private sector for solving social problems. This has been true in particular for labor-management relations (Fujita, 1988: 584). Associations of big business, which are actively involved in state economic policy-making, defend their employees' interests through corporate welfare programs at the expense of small and medium sized subcontractors and the rest of the working class (Fujita, 1988: 586).

Technopolis program can be considered as the product of state monopoly capitalism, Japanese hybrid model. The historical existence of technopolis program goes back to 1970s. Broadly speaking, the Technopolis plan is one of the two major industrial policies accompanying a regional industrial policy to exist since the Second World War in Japan (Fujita, 1988: 581-582). The other was the high economic growth policy of the 1960s (Fujita, 1988: 581-582). The technopolis program is one of a number of urban and regional technology-led developments with a bias towards peripheral regions that are currently being implemented throughout Japan[34].

The formal origin of the technopolis program lay in late 1979, when MITI[35] began studying the possibility of creating a Silicon Valley in Japan (Castells and Hall, 1994: 114-115). According to Masser, "the real strengths of technopolis policy lie as much in the way that it gives a new dimension to growth pole and new town ideas and in the procedures used by central government in Japan to stimulate local efforts, as in technology policy itself" (Masser, 1990: 50-51). According to Castells and Hall, "technopolis program marked a novel approach for MITI; instead of a top-down approach, the prefectures would play the crucial role in planning and constructing the technopoles, with MITI's role limited to setting basic criteria and providing technical assistance, advice, tax incentives and loans from the Japan Development Bank" (Castells and Hall, 1994: 116-117).

"It was important that the technopoles would be not merely high-technology production centers, but would also develop local innovative R&D capacity to help trigger the development of such industries locally. ... The R&D capacity would be built up in two parallel ways: first through relocating existing high-technology industries from the congested metropolitan areas, and second through assisted self-development of existing local industries....Thus the program was supposed to benefit not only big enterprises, which would be more likely to relocate or set up branch plants, but also small and medium ones, so ... assisting grass roots technological revolution." (Castells and Hall, 1994: 116-117)

For MITI, however, there was another objective of the program: it was to discourage offshoring, also known as hollowing-out, of the Japanese economy (Castells and Hall, 1994: 116-117). Since 1975 Japan's major business groups have been shifting production abroad (literally around the globe) in response to rising domestic wages and land prices, and more recently to counteract the protectionist measures of developed countries (Glasmeier and Sugiura, 1991: 410). As time passed, subcontractors were compelled to shift labor-intensive low-value-added production to other Asian countries simply to remain competitive (Glasmeier and Sugiura, 1991: 410). Cabinets in the mid- and late 1980s stated their intention to use their power to stimulate a more inward-looking development process: instead of exporting manufacturing plants to Taiwan or Malaysia, Japanese companies would be encouraged to move them to the underdeveloped peripheral regions of Japan (Castells and Hall, 1994: 116-117). Coupled with this was the notion of a rural social development plan including production, education and quality of life, aimed at developing a new rural culture that would cause migrants to come back from the congested metropolis to their regions of birth (Castells and Hall, 1994: 116-117). "In Japan, however, a limited number of charismatic people can realize the entrepreneurial phenomenon. Highly educated people rarely leave large corporations in Japan. Combined, these factors cause Japanese ventures to be difficult to start and to grow too slowly." (Ohe, Honjo, Oliva and Macmillan, 1991: 144)

A model similar to state monopoly capitalism was also employed in China. Beijing Industrial District of China illustrates how a country employing command state model can create an industrial district that is partly similar to the ones observed in West. "Since the late 1970s, China has undergone a period of dramatic change. Under the multifaceted reforms of its economy, China has issued a set of programs and measures which have provided the conditions to decompose rigid institutions and to liberate the productive forces. These conditions have set up not only a macroenvironment for a market-oriented economy, which is open to more domestic and international competition and cooperation in general, but also an innovation atmosphere for the birth and growth of flexible, self-financing, technology-based firms. The best illustration of the latter is the 'Electronics Street' in Beijing and its surrounding area, Zhong'guancun new-tech center." (Wang and Wang, 1998: 683) "Although the Chinese government had heavily invested in this region for decades for the purpose of promoting research and tertiary education, it was not until the early 1980s that the commercial value of scientific and technological knowledge was recognized by the centrally planned economy." (Wang and Wang, 1998: 683)

"A better innovative atmosphere emerged in the early 1980s when the economic reforms in China began. ... A set of reform measures regarding China's institutional system managing its development of science and technology had been introduced into universities, research institutes of Chinese Academy of Sciences (CAS) and ministries under the State Council, and the state-owned industrial firms. The state government managed to restructure the existing research institutions by establishing some market-oriented mechanisms. For example, the state heavily cut the basic funds for research and development in all institutes under the CAS, and the CAS was encouraged to set up self-financing and market-driven firms." (Wang and Wang, 1998: 685) A bottom-up trial started in 1980 when a few professionals acted as risk takers and devoted themselves to an early experiment for establishing non-state-owned firms in the region. Since then, new firms founded by academic researchers have emerged one after another (Wang and Wang, 1998: 685). And the 'Electronics Street' has appeared.

3.1.3. Low Regulation Systems: Entrepreneurial State Model

Dominant 'entrepreneurial state' develops an active program of deregulation, privatization and decentralization. It is based on the private sector's dominance of technological development and industrial production. Entrepreneurial state offers the industry tax incentives geared explicitly to promoting the seeking of short-run capital gains instead of supporting long-term planning by stabilizing the environment. In entrepreneurial state model, the role of state in shaping the high-tech landscape is indirect. The location of government R&D Institutes attracts private sector high-tech industrial production and subsequently a high-tech incubation center emerges as a result of spin-offs from nearby government R&D Institutes and local universities. The government procurements of high-tech based military, health and space products fuels the rapid development of high-tech industrial complex. In entrepreneurial state model, government policies at the state and local level have tended to follow the patterns already set by private firms. Most state programs for venture capital, government procurement of technological products and R&D assistance are found in states where high tech firms are already clustered (Malecki, 1985: 365).

The classical example, Silicon Valley, at the beginning was a construct of a small number of powerful institutions, and **not a 'cluster' to which independent firms were attracted by market forces** (Harrison, 1994: 322 and Saxenian, 1990: 96). Two powerful institutions - DoD (Department of Defense of USA) and Stanford University - played the greatest role in transforming this region of fruit orchards into a world center of microelectronics-based high-technology industry in the first place (Harrison, 1994: 322). It was mostly individual efforts that have created the Valley. The first of the heroes, Frederick Terman[36], professor of electrical engineering at Stanford and later dean, and vice-president, is often credited with having launched the concept of the university-industry partnership. He founded the nation's first high-tech industrial park located on university property, and managed the transition in military-related university R&D from radar and microwave communications to control systems for ballistic missiles (Harrison, 1994: 322 and Castells and Hall, 1994: 16-17). The idea was that close location to research done in universities would help improve the development and commercialization of basic research breakthroughs (Massey, Quintas and

Wield, 1992: 70). It was during Terman's years that such companies constructed facilities adjacent to Stanford University[37]. Because of its location as the country's westernmost outpost during the Asian war, California was by 1945 already the base of operations of much of the US aircraft, radar, and atomic energy industries (Harrison, 1994: 322; and Castells and Hall, 1994: 16-17).

Second hero of Silicon Valley was Nobel Prize winner William Shockley - co-inventor of the transistor. Shockley founded his own firm (Saxenian, 1984: 171 and Castells and Hall, 1994: 16-17). Two years later in 1957, eight of Shockley's best scientists spun off their own start-up and gained financial backing from the local Fairchild Camera and Instrument Company to start their own firm (Saxenian, 1984: 171 and Castells and Hall, 1994: 16-17). Virtually every established semiconductor firm in the valley can trace its genealogy back at least indirectly to roots at Fairchild (Saxenian, 1985: 25). Among Fairchild's spin-offs are Intel (created by Bob Noyce in 1968), National Semiconductors, Signetics, Amelco and Advanced Micro Devices, all leaders in the industry today (Castells and Hall, 1994: 16-17).

"The region's most dynamic growth phase was associated with the birth of a revolutionary new industry, the semiconductor (microelectronics) industry." (Saxenian, 1985: 25) "The vast majority of scientist, engineers and technicians in the microelectronics industry acquired state-of-the-art theoretical and practical knowledge in government-financed university or corporate research and development programs." (Harrison, 1994: 323) DoD and NASA support was critical in the establishment of the learning economies because military financing and NASA permitted companies in the Valley a degree of trial-and-error exploration of new technologies that private sources of finance would never have allowed (Saxenian, 1984: 170; Castells and Hall, 1994: 18-19; and Harrison, 1994: 323). "Research grants were awarded to universities and private laboratories, helping to fuel the creation of pools of scientists, engineers, and computer programmers." (Harrison, 1994: 323) Small start-up companies also received Pentagon procurement contracts, which helped to create what would later become the basis for networks of diversified suppliers and subcontractors to the big firms." (Harrison, 1994: 323)

By the mid-1960s the composition of markets had changed and military demand had declined significantly in importance relative to the newer computer and industrial markets, but the original concentration of semiconductor production in the county acted as a powerful centripetal force for the continued clustering of new semiconductor and electronics firms (Steed and DeGenova, 1983: 264; Saxenian, 1985: 28; and Harrison, 1994: 324). "The

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number of advanced degrees in engineering awarded annually in the region increased rapidly during these years. ... Santa Clara County had become an ideal environment for innovative, science-based industry. ... engineers and scientists simply left their employers in order to start their own semiconductor companies. ... External economies, including an enlarged supply of both skilled and unskilled workers, specialized inputs and services, and a social, cultural, and educational environment, made the region particularly appropriate for semiconductor production. ... By 1970 the county was known as Silicon Valley, the worldwide capital of the semiconductor industry." (Saxenian, 1984: 171)

"By the mid-1970s Silicon Valley had developed its social networks, its industrial basis, its supporting financial and service activities, and its professional organizations, to the point of constituting an innovative milieu able to absorb and propel into the market key innovations that were not of its own. That was particularly the case of the product that changed the world and the Valley, opening up a new industrial era for the region: the personal computer. The personal computer was first produced in 1974 - in Albuquerque, New Mexico, by an engineer, Ed Roberts, working out of his small calculator company, MITS - in the form of a model named 'Altair'. Altair, in spite of being a primitive machine, was an instant commercial success. But its main impact was to mobilize the informal network of computer hobbyists that was already in existence in the San Francisco Bay Area." (Castells and Hall, 1994: 18-19)

"These networks supported the development of another key ingredient of Silicon Valley, the venture capital firms, that were decisive in providing finance for the development of electronic firms outside the original narrow ground of military markets." (Castells and Hall, 1994: 18-19) But, against the common view on the matter, it seems that venture capital firms did not originate in the San Francisco financial markets, but from the wealth generated in Silicon Valley itself (Castells and Hall, 1994: 18-19 and Florida and Kenney, 1988: 37). Thus, the venture capital industry in California developed in tandem with its technology base. "The emergence of a technologically oriented investment community in California was a learning process characterized by the gradual accumulation of investment and management skills on the part of venture capitalists and entrepreneurs alike." (Florida and Kenney, 1988: 38)]

"*The* increased chip complexity demanded fabrication equipment which was far more sophisticated and costly than in the past. ... the small independent semiconductor companies of the past were rapidly being acquired or forced into merger with larger electronic systems producers or conglomerates. ... Capital formation, labor productivity, cost minimization, and marketing had thus replaced the former preoccupation with technological advance as the main concern of these leaders in an increasingly concentrated industry." (Saxenian, 1984: 188) "By the late 1970s, Silicon Valley's major semiconductor firms had thus changed from small, intensely competitive, technology-dominated ventures to large, mature, marketing-oriented corporations. ... Their increased size has given them the financial ability to disperse their advanced manufacturing operations. ... Yet the industry is not leaving Silicon Valley altogether. ... As manufacturing growth was directed elsewhere, the region was gradually being transformed into a high-level control center - the site of corporate headquarters and sophisticated research, design, and development activities. Eventually only the highest-paid professional and top managerial segments of the industry's work force remained in an increasingly expensive and exclusive white-collar enclave." (Saxenian, 1984: 189)

In sum "the region's two distinguishing characteristics were the unusually large supply of scientific and engineering manpower coming out of the universities, research institutions and laboratories in the area, and the huge market for semiconductors generated by the defense and aerospace contracts and subcontracts directed to the region." (Saxenian, 1990: 25) "Significant external economies had been created in the Santa Clara Valley which benefited small semiconductor companies with respect to manpower sources. No other area in the United States provided such a rich concentration of technologically skilled labor." (Saxenian, 1990: 26) Originally, there was nearly no forum in the region for the administrative coordination and strategic planning which is achieved by the management of a vertically integrated firm or planned development of developmental and corporate state models but today they feel that common and shared challenges are necessary to sustain the competitive advantage of Silicon Valley.

Another success story of entrepreneurial model is UK's M4 Corridor. There are three hypothesis for the Genesis of High-Tech Growth in M4 Corridor (Breheny, Cheshire, and Langridge, 1985: 127). "The first hypothesis is that of *indigenous technological growth*. This suggests that the seeds of the M4 technological developments and their subsequent growth were of British origin; *indigenous scientific and technological know-how and endeavor*. It is generally acknowledged that the piecemeal location of government research establishments in the area after the war has something to do with the initial, earliest developments and with subsequent changes." (Breheny, Cheshire, and Langridge, 1985: 127) "More and more highly educated and skilled staff were recruited to work with *government research establishments*. *In addition*, skilled and specialized sub-contractors in engineering, electrical

"The second hypothesis states that *technology growth* in the M4 Corridor was *imported*. Far from being a result of native genius and enterprise, events along the M4 owe as much to the National Aeronautical Space Administration in the United States as to the Ministry of Defense. ... In this view, the relationship of the major firms to indigenous public research facilities is largely coincidental." (Breheny, Cheshire, and Langridge, 1985: 129)

"A third possible hypothesis is a more complex one, consisting *of a hybrid of indigenous and imported determinants of growth*. This argues that whilst the origin of high-technology industry in the Corridor was originally mainly as a result of foreign multinationals such as Digital finding it a convenient location from which to penetrate the British and European markets, there was at a subsequent stage a change of causal mechanism. The presence of specialized labor and skills in the research establishments and defense industries when blended with the skills and resources of the incoming multinationals produced a large enough pool of interacting skills and demands for a genuine fusion to take place. At some stage, therefore, perhaps in the mid-1970s, sufficient agglomeration had occurred for internal and indigenous growth processes to take off." (Breheny, Cheshire, and Langridge, 1985: 129)

Whatever the genesis of high-tech growth in M4 Corridor is, the main motivation behind the development of the corridor was decentralization of office employment from the heart of London to M4 Corridor. What was happening in M4 Corridor is that the application of high-technology in office has produced a revolution in data processing, storage, retrieval and

Ottowa's TOC (Technology Oriented Complex) is another high-tech industrial district which is based on entrepreneurial state model. "Whereas the blossoming of Ottawa's TOC is recent, its origins, or at least its foundations, can be traced back over many decades. It seems reasonable to trace the origins back to at least the National Research Council (NRC), the establishment of which, in effect, gave rise to a research-oriented TOC. Following its modest beginnings as an Honorary Advisory Council in 1916, the NRC soon obtained labs to focus on applied as well as basic science, to help solve some acute national problems. Still, expansion was slow in the 1920s and 1930s. Subsequent evolution toward a complex *created by very large expenditures of government funds* received a major stimulus with the expansion of Canada's research and development capabilities, particularly in advanced electronic hardware necessitated during the Second World War. Employment in NRC's Ottawa labs was expanded more than ten-fold in those years. Then, in the two decades after 1945, many scientists and technologists were attracted to Ottawa to work in a variety of federal government departments or in such Crown corporations as Atomic Energy of Canada Ltd., contributing to the development of a major concentration of science and technology capabilities." (Steed and DeGenova, 1983: 266)

"It was not until after the Second World War that Ottawa's TOC also started to *attract manufacturing facilities of high-technology companies*. In fact, there was very few high-technology manufacturing firms set up in the Ottawa area before 1960. Among the early comers at least two have proved also to be incubator organizations with significant subsequent spin-off impacts in the founding of new firms. Computing Devices Ltd., started in 1948 to produce military computer hardware, was the first high-technology firm in the area. It subsequently became a source of local entrepreneurship, managerial talent, and technical expertise in the formation of several other local firms. Next, a decade later, came Northern Electric Ltd., the R&D labs of which subsequently became part of Bell Northern Research (BNR). Those two firms have spawned a number of offshoots, most of them formed during the 1970s." (Steed and DeGenova, 1983: 267)

"Ottawa's success as a high-technology center may be attributed to several locational advantages, the interaction of which may have become more cumulative in recent years as some synergy has evolved among the principal actors. These advantages are accessbility to the federal government; a well-developed science and technology community in the NRC, two universities, some Crown corporations, and several federal government departments (e.g. National Defense, Communications, Energy, Mines and Resources); the large labs of Bell Northern Research Ltd.; and a life-style based on an attractive sociocultural and recreational environment appealing to the skilled scientists, engineers, and technical personnel attracted by growth of the complex." (Steed and DeGenova, 1983: 265-266)

3.2. Components of the Regulation Mechanisms

Each high-tech region had a high concentration of scientists and engineers, but differed in the particular mix of institutions (university, government and industry), employing them and the degree of interaction between institutions (Figure 4). Regulation mechanisms are composed of universities, public and private R&D Institutes, government agencies, local governments, training institutions, local self-help organizations-foundations, industrial land developers, venture capitalists, banks and administrative bodies of high-tech regions. Each of them has fundamental influence on the creation of innovative environment. The contributions of institutions can be either information support or financial support. Universities and R&D Institutes provide the high-tech complex with scientific labor and information which are to the informational economy what coalmines were to the industrial economy. Central and local government agencies, foundations, venture capitalists and banks generally provide the high-tech region with financial type of support. Environmental quality, bureaucratic flexibility, and a good locational image also enhance the attractiveness of a high-tech industrial district. Most difficult of all is the creation of linkages and synergistic interaction between the various components of high-tech industrial district.

Information flows
Monetary flows

(1) Financial incentives and state technology procurements
(2) R&D projects sponsored by government and grants
(3) R&D projects sponsored by government and grants
(4) Provision of low interest loans and credits to spin-offs
(5) Building of R&D laborities and grants to students
(6) Grants to students and provision of laboratory equipments
(7) Sponsoring and encouraging firms to innovate
(8) Sponsoring spin-offs in their effort to commercialise innovation
(9) Sponsoring spin-offs in their effort to commercialise innovation
(10) Provision of physical infrastructure and cheap industrial land
(11) Partnerships in constitution of local high-tech base and admin.
(12) Provision of basic municipal services and facilities
(13) Partnerships in innovative projects and sharing laborities
(14) Creation of spin-offs to industry and free use of laboratories
(15) Creation of spin-offs to industry and free use of laboratories

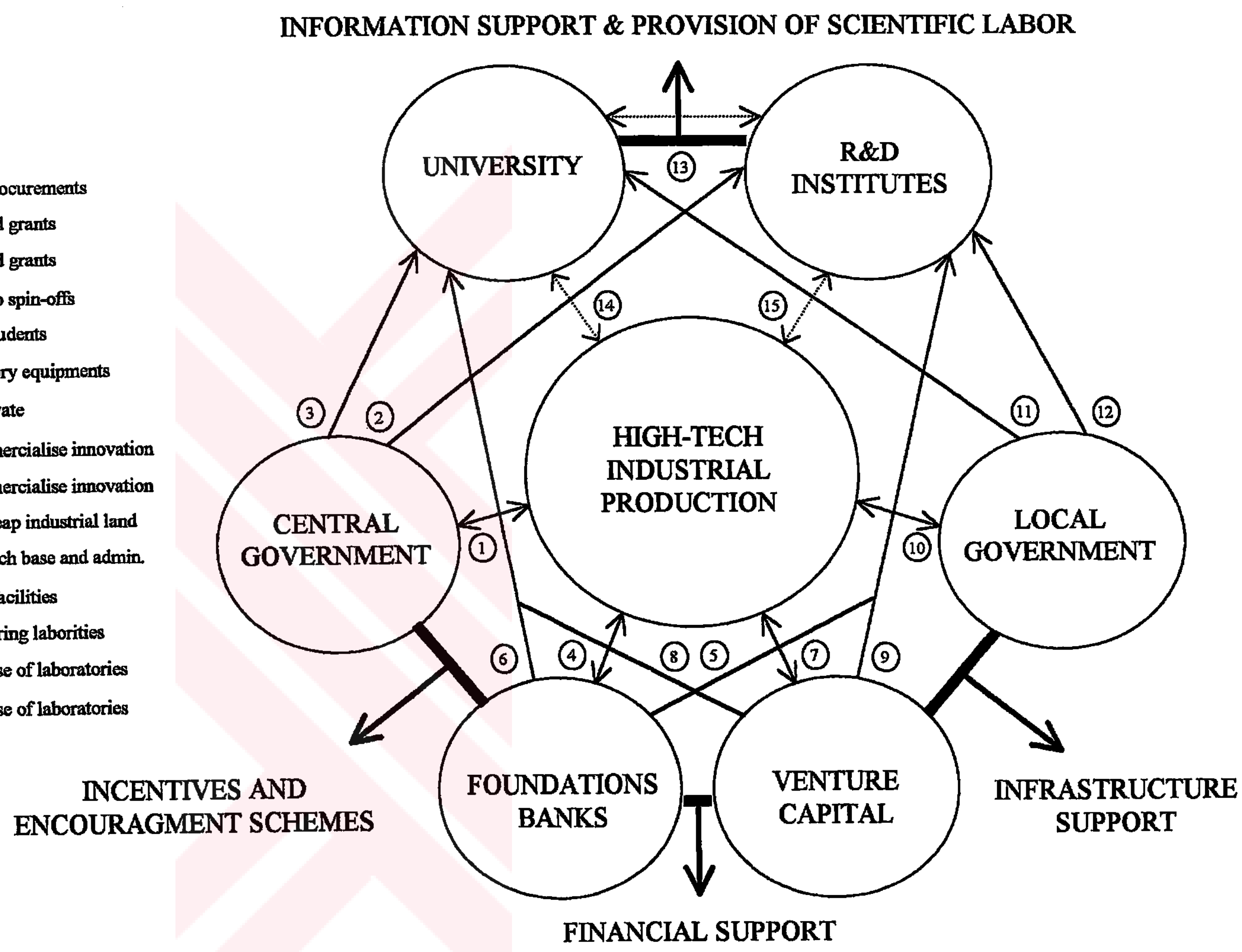

Figure 4 - Stereotyped Model of High-Tech Industrial District.

3.2.1. Central Government and Local Governments

Central government organizations play a wide range of roles. As in the case of MITI, they can be core institute of planning entire regional high-tech development. At the other extreme, as in the case of NASA and USA DoD (Department of Defense), they can support the high-tech development indirectly through government procurements of military and space related high-tech products. Central government support of high-tech industrial production is inevitable but the form and degree of intervention is very important.

Local governments do also play important roles in creating high-tech regions. First, investing in high-tech is attractive for local governments due to the job opportunities promised by high-tech development and economic repercussions of creation of more employment opportunities. In this way, they aim at increasing the well being of the region as a whole. Second, small and medium businesses are more tied to local governments than to the central state. It is therefore inevitable that central governments had to incorporate local governments to succeed in their own goal. UK's science park policy, Innovation Centers of Germany and Japanese technopolise program are based on the active involvement of local governments in governance of high-tech regions. The governance structure of UK's science parks is just illustrative of how local governments can be involved in technological development. There exist a corporatist interest mediation between the local actors involved in the creation of the science park. City Council (1), Local University (2) and Local Banks-Foundations (3) are the three actors involved in science park formation.

In Japan, there does exist a corporatist interest mediation between the central and local states (Fujita, 1988: 586). The best example of corporatist interest mediation between the central and local states is provided by the technopoles program. In 1983, as a second policy phase, a **regionalized** technology policy was introduced by the Technopolis Law enacted in that year (Stöhr and Pönighaus, 1992: 606). Fujita, Stöhr and Pönighaus claims that the idea of the technopolis, in fact, was not an invention of a central agency but rather it was borne out of developments in local states in 1970s (Stöhr and Pönighaus, 1992: 606, Fujita, 1988: 585 and Stöhr, 1985: 10). They argue that the role of central government was just to provide an organizational framework for and to reinforce local trend of 1970s (Fujita, 1988: 585 and Stöhr, 1985: 10). According to Fujita this is because of the fact that "state-led industrial policies of 1950s and 1960s did not bring the expected employment opportunities and local states at many levels began to develop their own development policies" (Fujita, 1988: 585).

Whatever the initial motivation is technopolis policy has certainly introduced a bottom-up approach into the Japanese industrial development.

The regulatory tools used by both central and local governments in high-tech creation efforts can be listed as following: financial incentives and encouragement schemes; provision of land and infrastructure; training and education programs. What follows is the detailed analysis of these regulatory tools with reference to their contribution in high-tech constitution.

3.2.1.1. Financial Incentives

In recent years there has been a great deal of interest in the relationships between technological innovation and regional development. The technology debate has brought a new dimension to regional development policy. Traditional instruments such as infrastructural provision and tax incentives are being given a sharper focus in the context of measures to reduce regional disparities through technology-led developments such as science parks or research and development activities. Social life and the politics of new growth centers emphasize high indices of the 'quality of life'. Quality of life, however, is not a transhistorical constant or a universal category, but a politically constructed one. It sometimes tempts location theorists into the surely incorrect assumption that technical/scientific workers autonomously seek out these quality of life standards, and that high technology industry then simply follows. But in reality it is mostly the financial incentives and encouragement schemes that attract high-tech firms to desired locations of agglomerations.

Special tax treatment, a form of financial incentive, appears to be the common characteristic of all planned and spontaneous type of high-tech developments (Steed, 1987: 262; Wang and Wang, 1998: 686-687; Stöhr and Pönighaus, 1992: 606; Scott and Angel, 1988: 1054; Fujita, 1988: 575; Masser, 1990: 41; Castells and Hall, 1994: 102-103; Scott and Storper, 1987: 229; Harrison, 1994: 310 and Lin, 1997: 264). Rather than providing direct national funds for high-tech development, national and local governments motivate high-tech firms to invest in high-tech industrial districts by providing tax incentives. A survey of American high technology companies by the Joint Economic Committee of Congress listed a region's skilled labor, **taxes**, and academic institutions to be its most important attractions to high technology companies (Steed, 1987: 262). Instead of supporting long-term planning by stabilizing the environment, the US government offers the industry tax incentives geared explicitly to promoting the seeking of short-run capital gains (Harrison, 1994: 310).

At the other extreme, in planned developments, tax incentives again play very important roles in the formation of high-tech industrial agglomeration. In Japan prefectures try to attract assembling and processing industries through various tax and financial incentives (Castells and Hall, 1994; Stöhr and Pönighaus, 1992: 606; and Fujita, 1988: 575). For example both Tsukuba and Kansai, which have the title of national projects, enjoy especially high levels of incentives specifically allowed by the Ministry of Finance. Incentives to the private sector - under 'a special law' applying only to the Kansai Research City - include lower land costs, property taxes and accelerated depreciation. Tsukuba has the same kind of provision, and so do many other developments; each has a specific law, with subtle variations from the rest. Financial incentives: as in all technopoles, national taxation on land and equipment is relaxed (prefectural tax holidays and subsidy on real estate acquisition and corporate tax); the precise rate of relief being left open for case-by case negotiations with the national tax authorities; the depreciation rate is halved; low-interest loans; special new enterprise potential loans; infrastructure subsidies to local authorities; and land is readily available at less than market value, for a negotiated price that varies greatly. (Castells and Hall, 1994: 136-137)

In Taiwan, machinery and equipment imported for use by HSIP (Hsinchu Science-based Industrial Park) enterprises are exempted from import duties and dues, commodity tax and business tax. Taxation incentives not only enhance HSIP's desirability to high-tech investment, but also help the capital accumulation of high-tech firms in HSIP (Lin, 1997: 264). The Government also devised a number of other tax-oriented policies to attract firms into the Park (Castells and Hall, 1994: 102-103). Firms in Hsinchu enjoy greater fiscal incentives than companies in the export processing zones. These include a five-year tax holiday, a maximum income tax rate of 22 percent and capitalization of investors' patents and know-how as equity shares. In addition, these benefits are not constrained by regulations that normally forbid tax-exempt manufacturers to sell in the domestic market. Tax exemptions, only available in Hsinchu, also include income generated from patents, logo rights, and consulting services. The Government also provides low-interest loans for the purchase of machinery, and makes possible joint-venture options up to 49 percent of total paid-up capital.

"As a regulatory institution, the Management Commission of the Beijing Experimental Zone for New Technology Industries (BEZ) handles affairs such as licensing, taxation, international trade, finance and investment, employment, and intellectual property for new-tech firms, largely in accordance with the stipulations of national policy but with slight local modifications." (Wang and Wang, 1998: 686) "The Management Commission of the BEZ devotes much attention to publicizing entrepreneurs and improving their images. It has implemented an incentive policy to make individuals enthusiastic. The policy of the BEZ towards promoting new-tech firms has been the provision of various kinds of incentives or relief, such as tax exemption and reduction." (Wang and Wang, 1998: 687) "Besides the effort of local government through the Commission, the central government also has a grants system which aims at stimulating innovation, such as the State Invention Award, State Torch Award, State Award for Science and Technology Advance, and State Natural Science Award. Small firms at the same time benefit from access to a range of grants." (Wang and Wang, 1998: 687)

The spatial structure of assembly costs also is illustrative of how taxation is important as a policy to attract high-tech firms to desired locations. The shift of assembly to offshore locations is above all an attempt to reduce production costs through cheap labor services, tax holidays, advantageous tariff regulations and the like. They are frequently associated with what is commonly alluded to as a 'good business climate' which means, in particular, favorable local tax arrangements for producers and an absence of significant labor union activity (Scott and Storper, 1987: 229). In many cases, governments in the world periphery and semiperiphery have offered further locational incentives particularly in cases where producers are willing to locate in special export-processing zones (Scott and Angel, 1988: 1054).

Tax holidays and exemptions are not alone enough to attract high-tech firms to desired locations of high-tech agglomeration. HSIP is illustrative of this fact. "In spite of the locational advantages, there have been debates as to whether the Hsinchu area is an ideal location for the Park. By 1985, 80 percent of Taiwan's information-related industries were still located in metropolitan Taipei. Many companies locate their production and part of their research activities in the Park in order to be qualified for the special tax exemptions, while keeping their headquarters in Taipei as centers of research, decision making and marketing. Therefore, Taipei, rather than Hsinchu Science Park, seems to be the real center of high-tech industry in Taiwan." (Lin, 1997: 266 and Castells and Hall, 1994: 108-109) In addition, the consumption characteristics of HSIP employees shows that there is strong links with Taipei City despite the fact that the local commercial environment in Hsinchu city had improved significantly (Lin, 1997: 266). Thus, it seems that Taipei is also the real center of cultural activities and shopping.

HSIP experience shows that tax schemes are also very critical from point of view of administration of the high-tech regions. The high-tech technology complex of HSIP is isolated from the Hsinchu City administratively. HSIP's administration is subordinated to the National Science Council. Budgeting for the Park is directly related to the National Science Foundation, bypassing the Hsinchu city and county government. This administrative separation between Park and locality has generated some conflicts, notably over taxation. The companies in the Park pay a limited amount of tax to the local government, but, because most companies keep their headquarters and sales in Taipei, the major portion of the corporate income tax goes there. Meanwhile, as the industries in the park keep growing, the Park administration plans to expand the Park. Since the local government is unlikely to benefit from this growth (not to mention the loss of control of valuable land), it has not expressed any major interest in cooperating with the Park administration. This has further enhanced the isolation of the high-technology complex from the rest of the region. As Taiwan moves toward democracy, and as local authorities play an increasingly active role, potential conflicts between local and national governments over the control of the Park's development and benefits could sour the future business atmosphere. (Lin, 1997 and Castells and Hall, 1994: 108-109)

Unless a tax incentive is based on a regional selectivity, there is no use of it in creating specialized high-tech districts. BEZ is especially illustrative from this point of view. New high-tech firms located in BEZ are provided with tax exemptions in order to promote them. However, the power of this policy has subsided because of the establishment of another fifty-one new-tech zones at the state level which apply the same tax policy (Wang and Wang, 1998: 687).

Tax exemption clearly plays important roles in attracting the high-tech firms to desired locations of high-tech agglomeration. But it is sometimes only zoning which function as the main source of attraction. For example, in pursuit of an expanded tax base, each of the early industrializing North County cities in Silicon Valley chose to rezone extensive tracts of land from residential to industrial usage (Hall and Markusen, 1985a: 146 and Saxenian, 1984: 182). Thus, the expanded tax base can reverse the roles played by taxation. It is the tax incentives which is attractive for high-tech firms at the early stages of growth of high-tech agglomeration but it is the tax revenues which motivates nearby localities to attract high-tech firms into their hinterland because of the mature phase of development of high-tech industries in close proximity. Thus, sometimes tax incentives can create cumulative growth effects. The major economic impact of high-technology may therefore be indirectly through the growth of the local tax base, rather than directly trough local economic growth multipliers (Feldmand, 1985: 77).

According to Lyons, these findings have implications for economic development strategies in advanced production centers. He argues that future development policies within advanced production centers should concentrate on promoting existing firms more so than attempting to poach firms from other states or attracting branch plants of large national/international corporations as growth of existing companies in advanced production centers is likely to deepen existing agglomeration advantages and to attract new companies without the expense of actively promoting relocation through **tax concessions** or other monetary incentives (Lyons, 1995: 275).

3.2.1.2. Land and Infrastructure Provision

Government agencies providing premises, land and infrastructure play crucial roles in creating high-tech agglomerations (Keeble et al., 1997: 11; Wang and Wang, 1998: 686; Stöhr and Pönighaus, 1992: 606; Castells and Hall, 1994: 104-105; Glasmeier and Sugiura, 1991: 410; Lin, 1997: 264 and Fujita, 1988: 568). Land and infrastructure provision by government agencies is generally observed in planned high-tech developments (mostly Asian Nations). Hsinchu in Taiwan, Technopolis Program in Japan and Beijing in China provide empirical evidence of effectiveness of land and infrastructure provision in formation of high-tech regions.

In Hsinchu lands were acquired and developed by HSIP and then leased to high-tech firms at a relatively cheap rate (Lin, 1997: 264). The Government procured land, built roads and facilities on the site, and developed housing and residential services to house the personnel of the firms locating there (Castells and Hall, 1994: 102-103). However, promising tenants were selected according to their high-tech attributes and development potential. Furthermore, HSIP may exempt collection of rental for no more than five years for land leased to a high-tech industry whose technology is deemed of greater value to industrial development. The 'lease only' policy not only reduces the capital burden, but also helps high-tech firms to start-up. While other technology parks have limited growth space, the continuous 'expansion' of HSIP has provided opportunities for high-tech firms to grow and new investments to enter. (Lin, 1997: 264)

"Through lawmaking, HSIPA is authorized to take over tasks of local governments in land use and building management, industry/business administration and public works, and to supervise the branch offices of related public services including customs office, high school, banks, post office and telecommunications station. With the centralization of authority to HSIPA, high environmental quality and efficient public service can be maintained for the residents and firms in the park." (Lin, 1997: 271) However, according to Castells and Hall, the reasons given for originally locating in Hsinchu were unconvincing as firms seems to come down to one fundamental reason: to please the Government. Thus, availability of land does not appear to be overriding reasons (Castells and Hall, 1994: 104-105).

Cheap land and infrastructure provision in Technopolis Program, on the other hand, is designed to prevent off-shoring of Japanese high-tech production (Castells and Hall, 1994). Since 1975 Japan's major business groups have been shifting production abroad (literally around the globe) in response to rising domestic wages and land prices, and more recently to counteract the protectionist measures of developed countries (Glasmeier and Sugiura, 1991: 410). As time passed, subcontractors were compelled to shift labor-intensive low-value-added production to other Asian countries simply to remain competitive (Glasmeier and Sugiura, 1991: 410). The technopolis is a national project but it aims to achieve regional development under the region's hegemony by making use of **existing land**, education and research facilities, and cultural and other assets of a region's heritage (Fujita, 1988: 568). The national technological objective was to offer to high-technology industries adequate industrial land, water and environment suitable for creative research, and resources which had become extremely scarce in the major metropolitan areas of Japan. The regional technological objective was to promote technological development in less developed and more remote areas of Japan (Stöhr and Pönighaus, 1992: 606). For example, land in Kyushu was 70-80% cheaper than in the three big metropolitan areas and wages were 20% lower. With this comparative advantage in land and wage prices, as well as with the prefecture's enthusiasm to invite assembly and processing industries, semiconductor-makers started to come to Kyushu (Fujita, 1988: 575). The availability of serviced industrial land has been also a key factor in Nagaoka's success (Masser, 1990: 52). In Japan the federal government exerts a great deal of influence on the structure and composition of small businesses through financial, consumer and especially land markets (Glasmeier and Sugiura, 1991: 406).

In China, the growth of 'Electronic Street' resulted in a serious survey by the Beijing government at the beginning of 1988. The government decided to make the Zhong'guancun region an experimental zone for new-tech development in China. A well-defined area of approximately 100 km² centered on the Electronics Street, was delineated as the Beijing Experimental Zone for New Technology Industries (BEZ), and wide-ranging benefits for the new-tech firms were enacted into law (Wang and Wang, 1998: 686). As a supporting institution, the Management Commission of the BEZ invests in the infrastructure needed for the new start-ups, some initial capital, and managerial guidance (Wang and Wang, 1998: 686-7). Furthermore, separate from the Electronics Street, a planned industrial park of 1.81 km², named Shangdi Information Industry Base (SIIB), was constructed in 1991 for production activities, sponsored by a state-owned Beijing Strong High-tech Development Corporation (Wang and Wang, 1998: 688).

Emphasizing the fact that planned high-tech developments are generally associated with strong involvement of government agencies in provision of land and infrastructure does not mean that spontaneous occurrences are lack of these provisions. The real distinction between planned and spontaneous high-tech growths with respect to land and infrastructure provisions is the fact that municipalities in spontaneous occurrences consciously take the responsibility of providing cheap land and infrastructure as they expect high rates of tax revenues in return. In contrast to planned developments where central government takes a direct responsibility to provide cheap land and infrastructure, in spontaneous occurrences municipalities are motivated by tax revenues to take these responsibilities voluntarily.

Silicon Valley is just illustrative of how this motivation is realized. Infrastructure and transportation networks had all been well established in the *Valley*, thus ensuring efficient and uninterrupted air service, easy transfer of products to the airport, supplies of energy and water and the necessary sewage facilities (Saxenian, 1985: 29). In spite of all these infrastructure developments, the urban contradictions of the Valley are highly perceivable in any instance. During its historical development, most of the county councils rezoned their areas to increase the industrial land available in order to attract more industries and benefit from taxes. Now, however, the area is in a trouble as nearly there is no land available for housing and those available at very high prices is impossible to be paid by low-wage workers (Saxenian, 1984: 186).

3.2.1.3. Training and Education Programs

The dictates of shorter production runs and frequent product and process innovation require workers who have the skills and knowledge to perform a wide variety of tasks and to take greater responsibility for the quality of finished product (Digiovanna, 1996: 383). Flexible specialization requires workers continuously to upgrade their skills and learn new techniques. This continuous learning is a necessity of information technology. Fortunately, in any community of workers, processes of habituation to the peculiar rhythms and imperatives of work in the local area are facilitated by the forms of culture and consciousness that develop there. This socialization is further enhanced where specialized educational institutions and training establishments are set up in the community (Scott and Storper, 1987: 224 and Lyons, 1995: 266-267). For example, a very important source of entrepreneurs, principally in the metal-working sector of Emilia-Romagna, is technical schools, which have a long history in that region. Those schools combine theoretical and practical training (Storper, 1993: 438). Where these facilities are publicly provided or subsidized, producers gain the advantage of deprivatization of at least part of the costs of job training and basic research and development (Scott and Storper, 1987: 224 and Lyons, 1995: 271). Teaching programs become important endogenous elements of the overall process of local territorial reproduction (Storper, 1993: 438).

The most significant ingredients within the process of creating a high-tech region is the establishment of high-quality labor training and support of productivity strategies designed to meet the needs of firms in the 2000s. As technology is more mobile than other factors of production, it causes disintegrated facilities to require large pools of higher skilled labor. In many countries, postsecondary high-technology vocational training system's emphasis has relatively shifted from plumbing and carpentry to computer-system maintenance and computer-aided design (Amirahmadi and Wallace, 1995: 1745).

Labor training programs and training programs to educate firms about just-in-time production, quality control, resource-sharing benefits are employed in numerous high-tech industrial districts in order to preserve their competitive advantage. In addition, the education and training facilities also eliminates high degrees of credential exploitation as the skill shortages that bid up the status and conditions of one small stratum of employees must be seen in the context of low educational and training levels for other employees (Massey, Quintas and Wield, 1992). According to Florida, the education and training system must be a learning system that can facilitate life-long learning and provide the high levels of groups orientation and teaming required for knowledge-intensive economic organization which is characterized by a much higher degree of reliance on outside suppliers and the development of co-dependent complexes of end-users and suppliers (Florida, 1995: 532). Thus, training and education (continuous learning process) is a necessary component of high-tech industrial production (Keeble et al., 1997: 11).

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The lack of coordination and organization within small firm complexes has precipitated discussions about the need for governing systems to regulate small firm atomistic behavior and to replicate functions performed by the vertically integrated corporations such as training (Glasmeier, 1991: 470). As Saxenian's work suggests, network production systems are vulnerable to technological threats from the outside. That is why although labor training and education programs can be considered as part of the planned high-tech occurrences, the world experience shows that in most spontaneous high-tech growths there is also need for training and education programs (Saxenian, 1990: 106).[38] A more recent evaluation of the growing community competition for high technology industry in the United States found that most of the programs are designed to encourage technological innovation and local business development by mobilizing resources or removing barriers in six general areas: research, development and technology transfer; **human capital, including education and training**; **entrepreneurship training and assistance**; financial capital; physical capital, such as incubation facilities; and information gathering and dissemination (Steed, 1987: 264).

Labor training and education programs can be realized by a wide range of institutes; ranging from local technology transfer centers to high-quality university programs sponsored by governments and universities themselves. For example: TESA and JÆRTEK[39] (Jæren's Technology Center) in Jæren; Land Government in Baden-Württemberg and technical schools in Emilia-Romagna[40]; CSEM SA (Swiss Electronics and Microtechnological Center) in Swiss Jura Arc[41]; ITRI (Industrial Technology Research Institute) and ERSO (Electronics Research and Service Organization) in Hsinchu[42]; St. John's Innovation Center and The Oxford Trust in Cambridge; SDA (Scottish Development Agency) in Silicon Glen; Trinity in Silicon Fen; SYMIVAL in Sophia-Antipolis; Nagaoka Technopolis Foundation[43] in Nagaoka Technopolis; The Kumamoto Technopolis Center, Electronics-Aided Machinery Research Center, Precision Machinery Technology Research Center and Applied Electronics Research Center in Kumamoto Technopolis[44]; and similar institutes for each Technopolis together with Institute of the Small Business Corporation[45] in Japan provides the basic research and training infrastructure for their respective region. They support technological development among the member firms and offer training preparing workers and pupils in technical schools for the advanced industrial production. The implementation of regionally-based training program allows firms to share the risks when developing a highly-skilled workforce (Digiovanna, 1996: 383).

3.2.2. Universities and Higher Education Institutes

Generally, quasi-autonomous bodies like universities seem to be better generators of synergy than non-autonomous government institutes, especially those that are defense-related. In most of the science cities which are products of messianic dreams of developmental state, the tight hierarchies in both the public institutes and the private corporations may have been to blame (Castells and Hall, 1994: 230). But in general universities have played a fundamental role in the development of some of the most innovative technological milieux, such as Stanford at the origin of Silicon Valley, Cambridge University or MIT starting the spin-off process in their areas of influence (Castells and Hall, 1994: 230-231). Yet other major universities have never generated major technological centers; while others, despite their location in the heart of a metropolitan innovative milieu, have developed few industrial linkages.

Universities are major forces of attraction for high-tech firms (Hall and Markusen, 1985a: 148; Hall, 1985: 11; Taylor, 1985: 136-137; Lin, 1997: 257-262; Amirahmadi and Wallace, 1995: 1755; Scott and Storper, 1987: 220; Malecki, 1985: 350; and Masser, 1989: 46). They may play three different roles in the development of a high-tech region - though occasionally, in some privileged locations, the same university may involve itself simultaneously in all three (Castells and Hall, 1994: 230-232). Firstly, they provide new knowledge and technical services which their respective region's enterprises often cannot afford individually (Saxenian, 1990: 96). They help the diffusion of knowledge through networks of institutions (Hassink, 1997: 10). University research centers performing scientific activities attract firms to nearby locations (Feldmand, 1985: 76). Substantial R&D expenditures realized by universities ensure sustained technological upgrading of local small and medium sized firms (Florida and Kenney, 1988: 35; Castells, 1996; Harrison, 1994: 324; and Hall and Markusen, 1985a: 145). Conducting research and development through the cooperation of industry and university makes it possible for small and medium sized firms to drain into results of university R&D studies (Fujita, 1988: 568). Joint venture with private companies also enhanced the abilities of universities through contributions to the university budget (Masser, 1989: 50). Many authors also agree that the formative role of the universities in all high-tech regions is inextricably bound up with government spending influenced directly or indirectly by military-geopolitical considerations.

It may be questioned whether academic institutions less steeped in a tradition of research at the frontier of developments in science and technology can provide stimulus to regional innovation (Steed, 1987: 263). In this sense, research-oriented universities are to the informational economy what coal mines were to the industrial economy (Castells and Hall, 1994: 230-231). For various reasons, universities are better suited to this role than either private or public research centers. Of course, all these arguments do not apply to universities that are pure teaching factories, or those where a bureaucratic structure disassociates the reward system from scientific productivity (such as Akademgorodok). Such universities will be extremely unlikely to act as the generators of advanced technological milieux.

Secondly, universities create substantial number of spin-offs and scientific labor. The close cooperation between industry and university facilitate the adaptation of new graduates into high-tech industrial production (Masser, 1989: 50). The labor agglomerative advantage stems from the transfer of the costs of job training and basic R&D from the private to the public sector (Lyons, 1995: 271). Unusually large supply of scientific and engineering manpower coming out of the universities, research institutions and laboratories is the basic characteristic of many high-tech industrial districts (Castells and Hall, 1994: 230-231; Storper, 1992: 446; Markusen, 1985a: 45; Masser, 1989: 52; Harrison, 1994: 323-324; Saxenian, 1985: 25; Digiovanna, 1996: 383; Keeble et al., 1997: 3; Castells, 1996; Hall, 1985: 17; Steed, 1987: 262; Weiss, 1985: 85; and Taylor, 1985: 136-137). Significant concentrations of human capital can be realized in close proximity to major universities (Florida and Kenney, 1988: 35). Universities that engage in education and research relevant to high-tech development provide high-tech firms with high-quality engineers.

Thirdly, universities can take direct roles in establishing the nucleus of high-tech industrial districts. Universities sometimes are more influential than local governments (Digiovanna, 1996: 382). Universities may assume a direct entrepreneurial role, supporting the process of spin-off of their research into a network of industrial firms and business ventures (Castells and Hall, 1994: 230-231). They are more actively involved in administration and establishment of high-tech centers (Fujita, 1988: 569-581). The famous Silicon Valley was also established at the beginning as a high-tech industrial park located on university property (Castells and Hall, 1994: 230-231; Harrison, 1994: 322; and Taylor, 1985: 141). Universities can also take active roles in informing firms about the necessity of collaboration. The active participation of local universities to the creation of high-tech centers has been particularly important in the technopolis program of Japan (Stöhr and Pönighaus, 1992: 606). Some of the innovation centers in Germany and Science Parks in UK, within or alongside a university campus, which provide small units for firms growing out of research or expertise within the university is examples of university-led high-tech developments.

As explained above, universities clearly play a significant role in the formation of some of the high-tech complexes, but that does not mean high technology complexes can necessarily germinate in proximity to universities (Steed, 1987: 263; Oakey, 1985: 101; Lyons, 1995: 270; and Asheim, 1997: 21). In most cases their role is the direct one of providing a cultural amenity to attract new engineers and scientists (Steed and DeGenova, 1983: 264). Ottowa's TOC, Denver-Boulder Region in USA and Jæren in Norway are three examples. For Ottawa, local universities and provincial-local government policies were largely insignificant (Steed, 1987: 265). According to Steed and DeGenova, why new Silicon Valleys are not being 'dug' in Britain and Europe despite new attempts to stimulate their development is neither lack of risk capital nor the quality of infrastructure such as local universities, but probably the lack of opportunities for venture capitalists when too few top brains are attracted to entrepreneurship (Steed and DeGenova, 1983: 264). There is university but there is no spin-off. The building of a large pool of scientists, engineers and technicians is important. However, in the case of Ottowa that pool did not derive from the formation of major universities (Steed, 1987: 265).

In Jæren the technological cooperation was strongly dependent on the high level of internal resources and competence of the firms, and did not originally involve R&D institutions in the regional 'capital' of Stavanger. However, in later years, regional and national R&D institutions have gradually become greater involved in the R&D work (Asheim, 1997: 21). In Denver-Boulder Region access to universities and government research laboratories were among the least important location decision factors (Lyons, 1995: 270). According to Lyons, advanced production areas do not require access to universities for basic R&D (Lyons, 1995: 271). He adds that universities and government research laboratories are best considered a contingent factor at least during the early development of the high technology clusters (Lyons, 1995: 271).

The impression created by the previous literature that American firms might maintain more abundant and technically important links with local and national technical universities is also found by Oakey to be false in the Bay Area (Silicon Valley) sub-sample (Oakey, 1985: 102). "Bay area interviewees frequently stressed that their technical capacity was totally 'in house' and that they believed universities would not be able to offer technical help for innovation in their highly-specialized production niche." (Oakey, 1985: pp: 106-107) However, Oakey notes that these comments on small firms should be qualified by the acknowledgement that more formal and large-scale contract research programs may exist between Stanford and Berkeley universities and larger Silicon Valley corporations (Oakey, 1985: pp: 106-107).

The general rule is that the more purely academic the university, the less likely its contribution to high-tech development (Castells and Hall, 1994: 232). This is what has been experienced in Akademgorodok, Taedok and partly in Tsukuba. They are all characterized as being the products of messianic dreams of national charismatic leaders. They are all constituted by relocation of existing universities to designed special areas of innovation. As explained before, there is no manufacturing activity and little connection between the research activities and the productive activities in all these three science cities. The real lesson derived from these science cities is that moving the research units from their original networks may hamper the quality of the research, by increasing their isolation vis-a-vis national and international scientific milieux. *In addition to this,* the more a high-tech region is based on public research institutes, the more it is difficult to link up with industrial applications that make the research economically useful.

But there is another rule. Universities can only play their innovative role if they remain fundamentally autonomous institutions, setting up their own research agendas, and establishing their own criteria for scientific quality and career promotion (Massey, Quintas and Wield, 1992: 75 and Castells and Hall, 1994: 230-231). Thus, autonomous research universities, vocational universities, and entrepreneurial universities, based on scholarly quality and academic independence, yet linked to the industrial world by a series of formal ties and informal networks, are fundamental sources both of new information and of the human capacity to handle it. They provide both the raw material and the labor force that high-tech industrial districts need.

3.2.3. Government R&D Institutes and Technology Development Centers

It is sometimes government R&D Institutes rather than universities that provide the raw material of high-tech development. Government R&D Institutes in close proximity to high-tech agglomeration (as in the case of Silicon Valley, M4 Corridor of UK and Ottowa's TOC) help to diffuse technological know-how, fuel the radical innovations and create spin-offs. Due to their direct involvement in breakthrough innovation, government R&D Institutes are more attractive for high-tech firms. It is may be because of this fact most of the spontaneous high-tech growths have taken place in close proximity to government R&D Institutes.

> "... the building of a large pool of scientists, engineers and technicians is important. However, in the case of Ottowa that pool did not derive from the formation of major universities. Ottawa is a center of both government R&D and industrial R&D in Canada. The government R&D is of long-standing and in many respects attracted

> some of the key performers of industrial R&D - such as the Bell Northern Research Labs, which rank in size among the top one per cent in North America." (Steed, 1987: 265)

Government R&D Institute play four different roles in the development of a high-tech region. The first three roles resemble the ones played by universities. They differ from universities in that they are active customers of high-tech products. This last role of government R&D institutes provides the main motivation behind breakthrough innovation. It is not only simply the concentration of skilled labor, suppliers and information that distinguish them. They provide technical, financial, and networking services that the enterprises often cannot afford individually. The effort required to overcome technological deficiencies associated with new technologies requires big amounts of capital and no single firm could afford the costs of developing such an uncertain technology. It is at this point that government R&D Institutes play important roles as both partners and customers of new technology.

> "The federal government also had a significant role as a customer in the formation of 16 per cent of those new firms. By contrast, the provincial role has been very small. ... In sum, the Ottawa model, therefore, bears only a minor resemblance to the better-known American models. Ottawa's high-tech development has arisen despite the absence of a strong research university and lack, until recently, of significant venture capital support." (Steed, 1987: 268)

3.2.4. Venture Capitalism and Funds

Classical banking systems choose not to invest in uncertain technologies as they involve a high dosage of risk. It is at this point that personal savings of adventuresome investors interested in high-technology play crucial role in fueling the creation of spin-offs. Those adventuresome successful high-technology entrepreneurs and investors who chose to reinvest their earnings in promising local start-ups are called as venture capitalists and the financial system consisting of them is called as venture capitalism. Venture capitalists are central to the constitution of high-tech industrial districts as they support and finance university spin-offs to take initiative in new technologies and products (Saxenian, 1990: 96; Hall, 1985: 17; Keeble et al., 1997: 12; Malecki, 1985: 350; Hall and Markusen, 1985a; Scott and Storper, 1987: 220; Steed and DeGenova, 1983: 264; Castells and Hall, 1994: 114-115 and Steed, 1987: 263). Small and medium-sized technology-based firms benefit from the local availability of venture capital providers

Experience of Silicon Valley is just illustrative of the fact that as increasing numbers of technology intensive companies became successful, a new 'space' for investment in embryonic technologies developed. *Many* of the venture capitalists are exbusinessmen, with technical training and business acumen (Oakey, 1985: 108). They invested their money in the next round of start-ups, having verified from their own experience the feasibility of the process, and feeling competent enough to judge the possibilities of the proposed new firms (Castells and Hall, 1994: 18-19). In addition to this, the San Francisco milieu consisted of a large pool of wealthy individuals and families with discretionary incomes (Saxenian, 1985: 27-28). They have also heavily invested in high-tech production. Thus, although in the 1980s major financial institutions opened up shop in the venture capital market in the Valley, during its first decades the Valley's own social networks created a self-support system of finance, reinvesting part of their wealth in fostering the next generation of entrepreneurs (Castells and Hall, 1994: 18-19).

Venture capital firms tend to cluster in two distinct types of areas: those with high concentrations of financial resources and those with high concentrations of technology-intensive businesses (Florida and Kenney, 1988: 34). Venture capital firms which are based in financial centers (New York, Chicago, London, Paris, Tokyo and Honk-Kong) are typically export-oriented, while those in technology centers tend to invest in their own region and attract outside venture capital. Venture capital investments flow predominantly toward established high technology areas. "In addition, the venture capital industry displays a high level of agglomeration due to the information intensive nature of the investment process and the importance of venture capital networks in locating investments, mobilizing resources, and establishing business start-ups. The existence of well developed venture capital networks in technology-based regions significantly accelerates the pace of technological innovation and economic development in those regions." (Florida and Kenney, 1988: 33) Attempts to understand the spatial pattern of new firms have found that venture capital and agglomerations of existing firms in high tech sectors are especially important factors in explaining spatial variations (Malecki, 1985: 361).

Venture investing is also characterized by high degrees of intra- and inter-regional syndication or coinvestment. "Venture investing is dependent upon tremendous information sharing between venture capitalists, entrepreneurs, consultants and a wide range of related actors who operate as networks to locate deals, organize companies, establish investment syndications and so on. Because of the intensive nature of this information flow, these venture capital networks tend to be personalized, informal and localized. Further, the relationship between venture capital firms located around concentrations of technology businesses and those in financial centers is to some extent symbiotic. The existence of extended venture capital networks around technology centers enables export-oriented financial firms to participate in a much greater number of investments." (Florida and Kenney, 1988: 34)

Substructure of venture capitalism provides detailed information on venture capital investment syndications or coinvestments. "Syndication is important because it enables venture capital firms to pool expertise and to share risks. Coinvesting typically involves a single 'lead investor'. This leader firm provides technical assistance to the portfolio company. In doing so, it safeguards the interest of the passive coinvestors. Often a venture capital firm will assume the role of lead investor on the basis of an informal agreement with the other coinvestors while receiving no additional compensation. Investment syndication thus allows a degree of geographical diversification of portfolios." (Florida and Kenney, 1988: 41) "Investment syndication is perhaps the crucial ingredient in the geography of the venture capital industry. Coinvesting 'loosens' but does not eliminate the spatial constraints on venture capital investing. While syndication enables venture capital firms located in financial centers to export their capital to *technology-oriented complexes*, the relationship between these financial centers and technology-oriented complexes is a symbiotic and structured one." (Florida and Kenney, 1988: 42) Venture capital firms located around technology centers possess both the skills and the networks needed to assume the role of lead investor (Florida and Kenney, 1988: 43).

The availability of venture capital and the existence of such networks also have the effect of attracting entrepreneurs and technical personnel to such regions creating a self-reinforcing cycle of innovation and economic development. Venture capitalists not only help to organize the process of innovation but function to a large extent as technological 'gatekeepers' (Florida and Kenney, 1988: 44). However, it remains doubtful that simply providing public venture capital can compensate for the absence of a well-developed technology infrastructure even though it is a crucial element in the process of regional restructuring (Florida and Kenney, 1988: 44).

Oversupply of the venture capital can be also harmful to the competitiveness of local production system (Florida and Kenney, 1990: 75 and Grove, 1987: 156-157). Grove points out this as below;

"*One of the aspects* of Silicon Valley is the regular and frequent appearance of new companies which come to life like Broadway plays. ... Only a small number of them become ongoing, established enterprises, while the majority of them open, get good reviews or bad reviews, and soon close. The engineers then simply go on to another company, maybe one just across the street. What fosters this short-term orientation is the great abundance of venture capital in the area. ... the preponderance of venture capital is a source of self-limitation. **Too much venture capital causes constant fermentation and a short-term orientation, and the coming and going of companies like so many Broadway plays self-perpetuating.** An even more destructive and dangerous element is the increasing proportion of venture capital that is of foreign origin, predominantly Japanese. ... Unlike the Broadway play, these investors make sure that they keep access to the technology generated by the short-lived venture and that an ongoing entity elsewhere reaps the benefits from it." (Grove, 1987: 156-157)

Florida and Kenney also note that;

"Me-too-start-ups, in dividing market share and talent among companies, weaken many in ways that can threaten the development of entire industries. ... Thus, clone companies may appear rational from the perspective of each entrepreneurial group and venture investor, but they often end up hurting the high-technology industry as a whole." (Florida and Kenney, 1990: 75)

Moreover foreign venture capital leads to the fact that in high-tech regions the time-span for technology development exceeds the life-span of the company because foreign investments are used for the acquisition of technology for exploitation in home countries (Grove, 1987: 159).

Planned occurrences of high-tech development is based on investment banking systems rather than venture capitalism even though they recognize venture capitalism as an important factor of high-tech industrial production (Glasmeier and Sugiura, 1991; Florida and Kenney, 1990; Castells and Hall, 1994 and Sternberg, 1996). For example banks in the Japanese Keiretsu system, rather than individual venture capitalists, are the core institutes of financial support for high-tech firm formation. This is may be because of the fact that in Japan, only a limited number of charismatic people can realize the entrepreneurial phenomenon as highly educated people rarely leave large corporations (Ohe, Honjo, Oliva and Macmillan, 1991: 144). In the United States any person with an advanced education can become an entrepreneur (Ohe, Honjo, Oliva and Macmillan, 1991: 144).

"*Japan is* also lack of 'soft' infrastructure. Prefectural governments seem to have concentrated on construction of 'hard' infrastructure - roads airports university and laboratory facilities, technology centers, and industrial/ research parks - and too little on the 'soft' infrastructure of R&D consortia, **venture capital funds**, and university research needed to drive the high-tech regions. In most cases there was no 'magnet' infrastructure or 'leading edge' research technology which could by itself attract or retain footloose high-technology firms." (Castells and Hall, 1994: 140-141)

Florida and Kenney assume that given the requisite mix of production factors, capital will automatically be made available (Florida and Kenney, 1988: 34). Even though a local venture capital industry or venture capital firm is not absolutely necessary to facilitate high technology business formations, well developed venture capital networks - such as California's Silicon Valley or Boston's Route 128 - provide tremendous incentives for entrepreneurial startups and thus have an important impact on regional development (Florida and Kenney, 1988: 34). Venture capital plays a catalytic role in 'social structures of innovation' by encouraging entrepreneurs to form new companies and by providing the capital and contacts to facilitate such business formations (Florida and Kenney, 1988: 35 and 43).

3.2.5. Investment Banking Systems

Investment banking system is generally associated with planned high-tech developments of Asian countries. It functionally corresponds to the venture capitalism of the West and is recognized as a necessary component of high-tech industrial production (Keeble et al., 1997: 11; Massey, Quintas and Wield, 1992: 168 and 199; Hassink, 1997: 10; Saxenian, 1990: 105; Castells and Hall, 1994: 114-115; Florida and Kenney, 1990: 72, Glasmeier, 1991: 482, Glasmeier and Sugiura, 1991: 407). The national systems of innovation and the selection regime driven by financial institutions, like investment banking systems, have played a significant role, making available venture funds or rationing available capital to pioneering firms (Garnsey, 1998: 373).

For example, the bank in the Japanese keiretsu system plays the role of central financial institution, a role that in some ways resembles that of venture capitalists (Glasmeier and Sugiura, 1991; Florida and Kenney, 1990: 72 and Castells and Hall, 1994). MITI has been able to control its developmental state through an iron grip on the supply of industrial capital through the great Japanese conglomerate companies (keiretsu). Keiretsu are essentially financed not through the stock market, but through loans from their **group** bank, which in turn are financed from Japan's Central Bank through a pattern of systematic over-lending; on top of that, capital is available from a large pool, the Fiscal Investment and Loan Plan (FILP), derived largely from tax-free post office savings accounts (Castells and Hall, 1994: 112-113).

There are two different types of Japanese conglomerate companies (groups); intermarket groups and independent groups. "Groups are usually organized around dominant companies, a banking institution and a trading company. Members of lesser scale and marked power are coordinated by various councils. Financial institutions are usually the leaders of intermarket groups. ... While each group's control of its member is paramount, intergroup stockholding is still significant. The pattern of control exerted within and across group members relates to the age of the group. ... Independent groups, although vertically structured, also exhibit a pattern of horizontal control. Banks are also key actors in independent groups, but their role is less domineering. Independent groups draw their financial resources from more than a single financial institution, ensuring leading industrial firms' greater autonomy." (Glasmeier and Sugiura, 1991: 400)

The Japanese Technopolis Program marked a novel approach for MITI and Japan: instead of a top-down approach, each prefecture plays the crucial role in planning and constructing its own technopole, with MITI's role limited to providing financial and technical assistance. The loans from the Japan Development Bank are used for the local development of high-tech industries. The banking system is also decentralized. Within each prefecture there exists a designated development bank which requests great detail about how funds will be expended (Glasmeier and Sugiura, 1991: 406-407). If small businesses deviate, they must repay their loans (Glasmeier and Sugiura, 1991: 406-407). Some regional banks are more farsighted than others and can identify new products that have market potential.

"The small business sector also provides assistance through associations known as shokokai. These non-profit organizations are trading groups that facilitate small business development. ... The trading group is financed by central and local government subsidies. The shokokai also assist small businesses in finding markets and in disseminating information about products and services. Shokokai view themselves as contributors to overall 'regional development'. As such, their efforts include improving shopping districts, providing street lighting, parking and other infrastructure needed for commerce. ... Some financial assistance is available, but these groups offer primarily technical support." (Glasmeier and Sugiura, 1991: 407)

"The Shoko Chukin Bank is another institution which provides assistance to Japanese small business. Founded in the late 1930s, the bank has been charged with the responsibility of 'promoting the establishment of small business cooperatives by loaning funds for their activities'. ... This bank directly funds joint ventures between factories, stores and warehouse facilities. Additionally, it supports rejuvenation of shopping districts and other modernization activities, and provides natural disaster and recession relief loans to prevent chain bankruptcies of subcontractors affected by the demise of a large corporation. Shoko Chukin Bank is also involved in offshore marketing of small business products, and provides management consulting and information services about world markets." (Glasmeier and Sugiura, 1991: 407)

Another country having extreme control of banking system is Switzerland. The influence of banking system over the Swiss Jura Arc was so dramatic that in the early 1980s SSIH (formed in the 1930s with the merger of Tissot and Omega to become a leading vertically integrated manufacturer) and ASUAG (in response to economic instability in the 1930s, movement manufacturing was concentrated in a single firm) were forced by the banks to merge to constitute SMH Group. One of the most dramatic changes arising from the merger was the introduction of a wholly new product, the 'Swatch', propelling the Swiss back into the low-priced segment of the market (Glasmeier, 1991: 482). Longstanding inefficiencies embedded in the production system had also resulted in bank ownership of some of the region's most famous and successful firms (Glasmeier, 1991: 482).

Science Parks policy of UK is just illustrative of how an efficient mix of banking system and venture capitalism can be realized. A hybrid financial support system can be observed in UK: the combination of venture capitalism and local investment banking system. In well developed high-tech regions of UK (for example Cambridge and Oxford regions), local banks records a relatively low quality rating by local high-technology enterprises with respect to venture capitalists (Keeble et al., 1997: 12). However, any high-tech agglomeration advantage from local source of external investment capital is minimal in South East England as the major source of investment capital is internal profits and it is dependent on local bank funding in Scotland (Oakey, 1985: 106). Local banks play important roles in UK's Science Park policy. For example, both Aston Science Park and Warwick Science Park was backed by important banks (Lloyds Bank and Barclays Bank respectively). Lloyds Bank contributed £1 million to Aston Science Park's venture capital fund, an acceptance of risk in expectation of long-term return (Massey, Quintas and Wield, 1992: 25-26).

On the other hand, the relative disdain of USA investment banking system from high-tech production partly stems from the fact that the present copyright laws offer firms little protection for new products (Hall, Markusen, Osborn, and Wachsman, 1985: 53). Software is treated as written materials, not a commodity, so that the more lenient copyright laws apply, rather than patent restrictions. Even when programs exist in written form, banks refuse to consider them as assets, again precluding access to bank funds. Capital needs at the beginning tend to drive small firms into mergers with larger firms that have internal funds at their disposal. Some of the small firms are driven to join a larger firm with a legal department and its in-place distribution system which generally has access to broader geographical areas. (Hall, Markusen, Osborn, and Wachsman, 1985: 53) And it is may be because of the well designed patent laws which provide public R&D institutes and firms with equity shares, Japanese firms are able to draw on a substantial amount of support from investment banking system. In Japan, government's direct interest in patents generated guarantees the sustained provision of financial sources through investment banking system.

CHAPTER 4

HIGH-TECH INDUSTRIAL DEVELOPMENT EXPERIENCE OF TURKEY

4.1. Technological Progress and Development of High-Tech Centers in Turkey

4.1.1. Policies and Goals Set in National Plans for Technological Development and Establishment of High-Tech Centers and Regions

It is very difficult to say that the scientific knowledge produced by universities and R&D institutes is successfully commercialized in Turkey. Whereas, by creating synergic interaction between universities and industries, it is possible to create mutual benefits for both groups. In this way, on the one hand, industries and universities can utilize the know-how embodied in scientific and industrial workforce, and on the other hand, small and medium sized high-tech entrepreneurs are motivated to innovate and create employment opportunities for regional development.

In Turkey, the university-industry partnership idea first emerged in the second half of 1980s (DPT, 1985: 159). Implicitly in the 5th 'National Plan'[46], there was a consideration for the establishment of techno-parks (DPT, 1985: 159). In the program proposed by the plan, it was mentioned that legal framework of the technoparks would be defined in order to take the first initiatives in this effort. In accordance with this, Undersecretariat of State Planning Organization (SPO) prepared a model proposal in order to determine: the centers around which technoparks will be established; the necessary processes and requirements; the type of incentives and encouragement schemes; and the general rules of establishing technoparks (Pakbeşe, 1996: 56-57). On January 17, 1989, this proposal was approved by the State Minister who is responsible for SPO and SPO was given the responsibility to conduct the necessary studies. In this framework, with the help of UNIDO (United Nations Industrial Development Organization), SPO prepared a report which for the first time brought a detailed consideration into the problem of realization of collaboration between university and industry. In the report, following topics are emphasized in order to establish and sustain technoparks:

- An administration council composed of experienced academicians and industrialists,
- An intellectual environment conducive to innovations,
- An infrastructure system for small and medium sized firms,
- The free use of library, laboratories and computer centers of universities and R&D institutes,
- The close contact with the innovative industrial firms,
- The attraction of researchers (scientists and high-quality engineers) to technoparks by providing them with certain incentives and encouragement schemes,
- Direct involvement of central and local governments especially in the provision of physical high-tech infrastructure.

In March 1990, the mission of UNFSTD (United Nations Fund of Supporting Technological Development) visited 5 'technopark'[47] projects (Middle East Technical University (METU), İstanbul Technical University (İTU), İzmir Technopark Inc. (İTI), Anadolu Technology Research Park (ATRP) and Turkish Scientific and Technical Research Council (TSTRC)) which are supported by UNIDO within the framework of the collaboration agreement between Turkey and UNIDO (Babacan, 1996: 20). They emphasized the following three basic principles of high-tech development: goals which are clearly defined and commonly shared by all the parties involved in high-tech constitution; an organisational structure which clearly defines the share of responsibilities and the form of relationships between different parties involved; and a supervisory mechanism which supervises and controls the success of the system, and assesses the results obtained.

In the 6th National Plan which covers the period between 1990 and 1994, it was explicitly mentioned that the necessary legislation would be realized in order to develop the collaboration between university and industry, and technoparks would become widespread by encouraging the enterprises to take initiatives in the establishment of technoparks (DPT, 1990: 310). Technological goals of the 6th National Plan are as following (Akbaba, 1994: 61-62 and DPT, 1990: 309); to increase the total number of researchers from 33,000 to 66,000; to employ at least 15 researchers per 10,000 persons and to increase the share of R&D spendings in GDP from %0.33 to %1.

In accordance with the national plan, Higher Council of Science and Technology (HCST) has become more active. Science and technology objectives which are defined in accordance with the National Plan for the period between 1993-2003 in the meeting of HCST on February 3, 1993, is as following (Buğdaycı and Renda, 1995: 55): to increase the number of researchers per 10,000 people from 7 to 10; to increase the share of R&D in GDP from %0.33 to at least %1 which represents the world standard; to increase the scientific ranking of Turkey to 30 among other countries; to increase the share of R&D realized by private sector in total R&D from %18 to %30; and to increase the priority given to the informatics, high-tech materials, bio-technology, genetic engineering, nuclear technology and space technology. The required preventions are categorized by HCST into four groups; first group covers preventions related with creation of financial resources; second group covers preventions related with creation of human capacity; third group of preventions aims to increase the share of private sector R&D in total R&D; and forth group of preventions aims to increase the contribution of Turkey to total R&D conducted all over the world (Buğdaycı and Renda, 1995: 55).

Unfortunately, maybe except for the establishment of Turkish Patent Institute, none of the technological goals set in the 6th National Plan and objectives set by HCST are successfully realized within the plan period (Table 14, 15 and 16). In the 7th National Plan, there was a clear recognition of these failures but the same intentions were again repeated (DPT, 1996: 60-63). In addition to the objectives previously defined in the 6th National Plan, in the 7th National Plan there were some other considerations on the issues of creation of risk capital, government procurement of technological products, greater involvement of private sector in R&D investments, establishment of national R&D networks, responsibilities of TSTRC, greater involvement of academicians in R&D activities and **establishment of technology development zones** (DPT, 1996: 63-66).

There are some initial developments in the formation of risk capital (Vakıf Risk). Moreover, TSTRC has been given the responsibility of selection and control of R&D projects. Furthermore, in accordance with the National Plan, the Ministry of Industry and Trade has prepared a proposal for the legislation of Technology Development Zones ('Draft Law for Technology Development Zones'). However, it is not yet approved by Grand National Assembly of Turkey (Interviews realized at the Ministry of Industry and Trade, 1999). Shortly, there are some signs of initial success but repetition of technological goals set in the previous national plan constitute a hindrance on the realization of the goals set in the 7th National Plan. The further consideration of this issue is available in the next section.

4.1.2. Practical Evidence on Technological Development Set in National Plans

Although National Plans have been giving special emphasis on the creation of technology intensive regions since the second half of the 1980s, Turkish science and technology policy is not clearly and coherently defined. This is the most predominant characteristic of Turkish high-tech policy, which explains the backwardness of Turkey in high-tech industrial district constitution. In Turkey, National Plans have accelerated the high-tech industrial district creation efforts and within the last decade there occurred some R&D improvements. But it is still not enough compared with the developed countries. The share of R&D expenditures in GNP (Gross National Product) is still very low compared with developed countries (Table 14). Developed and industrialized countries spend at least %1 of their GDP for R&D activities. In Turkey %0.38 of GDP is spent on R&D. This is far below the level of industrialized countries (Buğdaycı and Renda, 1995: 53 and Babacan, 1996: 22).

As seen from Table 15, the other basic ingredient of R&D system, human factor, is again very low in Turkey compared with the industrialized countries (Buğdaycı and Renda, 1995: 53 and Akbaba, 1994: 62). Parallel to this, contribution of Turkey into the scientific literature is also very low as articles published in international scientific journals and number of citation done for these articles can be considered as the outputs of R&D activities (Table 16). According to publications covered by International Science Citation Index, among the other countries Turkey has been ranked 37th in 1993 and 34th in 1994 after many years of being ranked 40th till 1990s (Buğdaycı and Renda, 1995: 54-55 and Akbaba, 1994: 62). But this does not show the quality of R&D activities realized in Turkey, it is at this point that number of citation done for scientific articles produced by Turkish scientists shows the real quality of R&D activities conducted in Turkey (Buğdaycı and Renda, 1995: 53).

The basic reason of the backwardness of Turkey in R&D activities is the fact that public and private mentality in Turkey does not give any premium to R&D activities. In most of the public organizations, responsible R&D bodies work undercapacity and generally deal with routine works. Moreover, the share of R&D expenditures made by small firms in Turkey is again very low compared with developed countries. Most of the R&D expenditures in Turkey are realized by large firms. All these show that, like experienced in other countries, in Turkey state intervention is necessary in order to fuse scientific knowledge and industrial production. All bureaucratic barriers should be minimized. R&D potential of Turkey should be developed and technological infrastructure should be properly utilized by the economic activities.

Table 14 - Research and Development Intensities (Gross Expenditures per Gross Domestic Product in Percentages).

Country	1975	1980	1985	1990	1991	1995
*Germany**	2.24	2.4	2.72	2.76	2.61	2.28
France	1.8	1.84	2.25	2.41	2.41	2.34
United Kingdom	2.03	2.3	2.27	2.18	2.11	2.05
Italy	0.93	0.86	1.13	1.3	1.32	1.14
Belgium	1.3	1.5	1.68	-	1.65	-
Netherlands	2.02	1.89	2.09	2.15	2.05	-
Denmark	1.08	1.04	1.25	1.63	1.7	1.82
Ireland	0.86	0.7	0.82	0.86	0.96	1.4
Greece	0.2	0.2	0.34	-	0.37	-
Spain	0.35	0.4	0.55	0.85	0.87	0.8
Portugal	0.3	0.33	0.4	0.54	0.6	0.61
Austria	0.92	1.1	1.27	1.42	1.5	1.53
Sweden	1.8	2.0	2.89	2.9	2.89	3.02
Finland	0.91	1.1	1.57	1.91	2.07	2.32
EU	-	-	1.91	1.99	1.96	1.84
Switzerland	2.4	2.3	2.7	2.9	2.8	-
Norway	1.34	1.27	1.62	1.8	1.65	1.59
Iceland	0.94	0.7	0.75	0.99	1.16	1.46
Turkey	0.2	0.6	0.7	0.32	0.53	0.38
Canada	1.15	1.17	1.43	1.47	1.52	1.61
USA	2.38	2.46	2.89	2.81	2.84	2.58
Japan	2.01	2.22	2.77	3.04	3.0	3.0
Australia	1.0	1.0	1.2	1.38	-	-
New Zealand	0.87	1.0	0.88	1.0	0.99	-

* *Until 1990 West Germany*

Source: Welfens, Audretsch, Addison and Grupp, 1998: 230.

In Turkey universities are more willing to participate in high-tech constitution efforts than private sector (Babacan, 1996: 23). Parallel to this, in Turkey R&D investments are predominantly realized by the public sector and especially by universities (Table 17) (Buğdaycı and Renda, 1995: 53, Renda, 1995: 53 and Akbaba, 1994: 62). This creates the greatest vulnerability of Turkish R&D because in developed countries industrial R&D investments constitute the majority of the total R&D investments. For example in the USA, Germany and Japan more that 65% of R&D investments are realized by industries (Buğdaycı and Renda, 1995: 53). In Turkey, like in Chile and Mexico, just opposite of this is true (in Turkey and Chile more that 65% of R&D investments are realized by universities).

Table 15 - Total number of R&D personnel of countries (per 10,000 work force).

Country	1988	1990	1992	1993	1994
USA[*]	77	77	77	77	77
Germany	143	142	132	125	-
France	117	118	120	124	125
United Kingdom	103	98	94	96	99
Japan	135	141	140	143	143
Greece	-	-	28	-	-
South Korea	-	-	-	-	52
Turkey	-	7	8	8	8

[*] Average 77 personnel (Buğdaycı and Renda, 1995: 53).
Source: OECD Main Scientific and Technology Indicators, 1995: 2.

Table 16- Comparison of contributions of Turkey, Korea and Spain to scientific literature.

		Turkey		Korea		Spain	
Years	Total Number of Publications	Number of Publications	Rank	Number of Publications	Rank	Number of Publications	Rank
1980	575024	390	41	175	51	2953	24
1981	598903	344	42	254	46	3094	20
1982	671395	350	44	321	46	3717	20
1983	665592	395	45	442	41	4130	19
1984	676480	380	44	440	42	4015	17
1985	693129	493	43	664	40	5334	16
1986	703964	520	44	733	40	6176	15
1987	693710	591	43	944	38	6600	15
1988	696171	660	42	1058	38	6948	14
1989	657331	815	41	1332	36	7638	13
1990	671772	925	40	1448	34	8560	13
1991	705629	1080	39	1820	33	9372	13
1992	716884	1354	38	2248	30	12122	11
1993	760796	1492	37	2839	28	13047	11
1994	780970	1789	34	3684	24	14106	11

Source: Buğdaycı and Renda, 1995: 54.

One argument put forward as the reason of low level of industrial R&D was that there was no protection for patents in Turkey (Renda, 1995: 54). However, Decree-Law No.551 pertaining to the protection of patent rights is in force as from June 27, 1995 (Turkish Patent Institute, 1997 and Türk Patent Enstitüsü 1997). Necessary legislation about the patent rights has been realized but it is still not realistic to expect some improvements in industrial R&D

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spendings. This is because of the fact that small and medium sized firms can not afford the cost of protection of patents obtained by them (a finding emerged from the interviews realized at METU and İTU). Firms can only invest in R&D activities provided that patent rights are cheaply available both in time and money. Another important mistake can be of even greater importance; Opportunistic behaviors favoring only applicable high-tech R&D investments can create harmful effects in the long-run as basic science, in this way, decrease in importance (Sankur, 1995: 54). Whereas, pure basic sciences are very important as they determine what will be the next generation of technologies and they provide countries with international respect (Sankur, 1995: 54).

Table 17 - R&D spendings according to the basic sectors in Turkey (in percentages).

Year	University	Other Public Sector	Private Sector
1983	57	28	15
1990	70	10	20
1991	71	8	21
1992	68	8	24
1993	67	10	23
1994	67	8	25
1995	69	7	24

Source: Tok, 1997: 20.

Compared with developed countries number of domestic patent applications and secured patents is very low in Turkey (Table 18 and 19). This is, of course, a natural outcome of very low amount of money spent on R&D studies. Consequently, in Turkey domestic patent applications are also very low compared with foreign patent applications (Table 20). Another important point emerges from Table 20 is the fact that domestic patent applications are less successful compared with foreign patent applications as domestic patent applications per granted domestic patent is far higher than foreign patent applications per granted foreign patent. However, domestic utility model applications is more successful compared with domestic patent applications. They are as much successful as foreign utility model applications (Table 21). Patent and utility model applications for medical products constitutes the majority of patent and utility model applications made in Turkey (Table 22). Other sectors of high-technology (electronics, new materials and mechatronics) receive relatively far lower patent and utility model applications than chemistry (Table 22). All these findings confirm the fact that technological goals set in National Plans are not adequately realized.

Table 18 - Comparison of Domestic Patent Applications According to Countries in 1995.

Countries	Population	Domestic Patent Applications	Number of People per Patent Application
Japan	125,000,000	335,061	373
Korea	43,000,000	59,249	726
Switzerland	7,000,000	5,116	1,368
Sweden	9,000,000	6,396	1,407
Germany	79,000,000	51,948	1,521
USA	249,000,000	127,476	1,953
UK	58,000,000	25,355	2,288
Norway	4,000,000	1,278	3,130
Austria	8,000,000	2,419	3,307
Holland	15,000,000	4,460	3,363
France	58,000,000	16,140	3,594
Israel	5,500,000	1,266	4,344
Russia	150,000,000	17,611	8,517
Poland	38,000,000	2,598	14,626
Spain	38,000,000	2,329	16,316
Greece	10,000,000	452	22,124
Portugal	10,000,000	96	104,167
China	1,069,000,000	10,066	106,199
Turkey	62,000,000	206	300,971

Source: Yalçıner, 1998: 58.

Table 19 - Comparison of Secured Patents According to Countries by 1995.

Countries	Population	Secured Patents	Number of People per Secured Patent
Switzerland	7,000,000	99,202	71
Sweden	9,000,000	93,383	96
Belgium	10,000,000	88,762	113
France	58,000,000	454,868	128
Holland	15,000,000	102,572	146
Japan	125,000,000	681,459	183
USA	249,000,000	1,110,357	224
Norway	4,000,000	15,585	256
Germany	79,000,000	291,997	271
Spain	38,000,000	95,739	397
Austria	8,000,000	19,100	419
Israel	5,500,000	11,868	463
Korea	43,000,000	63,021	682
Portugal	10,000,000	9,476	1,052
Czechoslovakia	10,000,000	6,447	1,551
Greece	10,000,000	5,731	1,745
Russia	150,000,000	76,186	1,968
Poland	38,000,000	14,792	2,569
Turkey	62,000,000	8,148	7,609
China	1,069,000,000	18,665	57,273

Source: Yalçıner, 1998: 60.

Table 20 - 1981-1998 Patent Applications and Granted Patents in Turkey.

	Patent Applications			Granted Patents		
Years	Domestic	Foreign	Total	Domestic	Foreign	Total
1981	157	368	525	26	254	280
1982	126	385	511	42	304	346
1983	157	354	511	56	244	300
1984	153	447	600	66	344	410
1985	132	461	593	61	324	385
1986	175	551	726	56	227	283
1987	138	760	898	63	257	320
1988	154	746	900	53	319	372
1989	154	894	1048	31	450	481
1990	138	1090	1228	48	438	486
1991	136	1073	1209	60	632	692
1992	190	1062	1252	54	621	675
1993	168	1071	1239	52	740	792
1994	148	1244	1392	61	1131	1192
1995	178	1520	1698	60	703	763
1996	187	718	905	47	554	601
1997	210	1329	1539	7	451	458
1998	213	2279	2492	32	764	796

Source: Türk Patent Enstitüsü, 1998b.

Table 21 - 1995-1998 Utility Model Applications and Granted Utility Models in Turkey.

	Utility Model Applications			Granted Utility Models		
Years	Domestic	Foreign	Total	Domestic	Foreign	Total
1995	34	3	37	-	-	-
1996	178	3	181	-	-	-
1997	213	11	224	113	4	117
1998	281	18	299	141	9	150

Source: Türk Patent Enstitüsü, 1998b.

A very effective political determination is necessary to overcome all these problems. In order to realize this, public sphere should be informed about the necessity of R&D activities through seminars and courses or publications and television programs (Babacan, 1996: 23). For example special TV programs on science and technology can be prepared or TV channels broadcasting mainly scientific and technologic programs can be established. In this way, young people can be directed to be interested in basic R&D. In addition, social studies should be directed to the problem of lack of coordination between universities and industries. Field studies should be conducted and potential entrepreneurs and firms should be identified. They should be informed about the fact that they can get state aids for their R&D activities and projects. SMIDO can organize all these activities and constitute provincial databases about the industrial structure of each province (Babacan, 1996: 23).

Table 22 - Distribution of Patent and Utility Model Applications According to Sectors in 1997-1998.

Sectors	**Application Percentage (%)**
Chemistry	38.6
Electrical Machinery	7.5
Non-electrical Machinery	8.7
Textile	4.7
Building	4.1
Agriculture-Agricultural Machinery	4.1
Highway Transport	3.9
Professional Knowledge, Measurement, Control, Optics	3.2
Plastics	3.1
Medical Equipments	2.9
Iron-Steel	1.9
Forest Industry	1.8
Electronics	1.7
Food	1.7
Burnty Clay, Cement, Ceramic	1.7
Metal Goods	1.4
Paper	1.2
Non-iron metals	1.1
Rubber	0.7
Glass	0.6
Arms Industry	0.5
Railway Transport	0.3
Petroleum Products	0.3
Ship Building	0.3
Leather Industry	0.1
Others	3.9

Source: Türk Patent Enstitüsü, 1998b.

The most important problem preventing the technological and scientific development of Turkey may be the fact that in Turkey science and technology policy could not be transformed into a national policy with the participation of all parties involved in high-tech constitution (Buğdaycı and Renda, 1995: 56). The uncertainties about the strategies employed in establishment of collaboration between universities and the industry together with the lack of required legislation defining the framework of Technology Development Zones in terms of provided incentives and supports gave rise to a host problems which have negatively affected the success of technoparks and technology development centers in spite of the willingness of the parties involved in the constitution of high-tech centers. Individually, these centers are not being able to be transformed into special spaces of real integration of science and production as so little innovative firms are created by them. What follows in the next section is the analysis of high-tech incubation and production centers of Turkey.

Table 23 - Methods of technological upgrading for the firms surveyed in Konya and Çorum.

Within the last three years, did you renovate your technology?	*Konya*	*Çorum*
No	30.61%	55.07%
Yes	69.39%	44.93%
Grand Total	100.00%	100.00%

Comparison of the methods of upgrading production technology	*Konya*		*Çorum*	
Data	Total	%	Total	%
By purchasing new machines	**27**	**55.10**	**26**	**37.68**
By changing the production process	**13**	**26.53**	**12**	**17.39**
Other methods (generally developing machines in-house)	3	6.12	5	7.25

Method of obtaining information about a new product or production method	*Konya*		*Çorum*	
Data	Total	%	Total	%
Social relations	**23**	**46.94**	**37**	**53.62**
Foreign seller firms	13	26.53	17	24.64
Firms selling machines	**20**	**40.82**	**41**	**59.42**
Fairs and exhibitions	**39**	**79.59**	**47**	**68.12**
Others°	2	4.08	-	-
Consultants working in this sector	13	26.53	18	26.09
People experienced in our field in Konya and Çorum	10	20.41	13	18.84
By visiting the firms located in provinces near to Konya and Çorum	5	10.20	22	31.88
By visiting the firms located in close proximity to our firm	10	20.41	30	43.48
Special publications	19	38.78	40	57.97
Libraries*	-	-	10	14.49
By employing those previously worked for other firms in this field*	-	-	15	21.74
Customer firms*	-	-	36	52.17
Maintenance and repair workshops*	-	-	10	14.49

* Not applicable for the survey conducted in Konya.
° Not applicable for the survey conducted in Çorum.

Source: Questionnaires of Çorum and Konya Surveys (Calculations by Beyhan).

4.2. High-Tech Incubation and Production Centers of Turkey

Technological and scientific development occurring in the last two decades has made the access to and rapid commercialization of all kinds of technological information necessary. This necessity gave rise to the emergence of high-tech industrial districts all around the world. High-tech industrial districts have been basic ingredients of national economic development. Technoparks have been designed to realize university-industry partnership in order to support innovative small high-tech firms and entrepreneurs as the transition from

'Industrial Society' to 'Informational Society' requires simultaneous integration of scientific knowledge and industrial production (Figure 5). Creation of spin-offs from technoparks and technology development centers creates new employment opportunities as sci-tech entrepreneurship lead to the full utilization of know-how embodied in scientific labor.

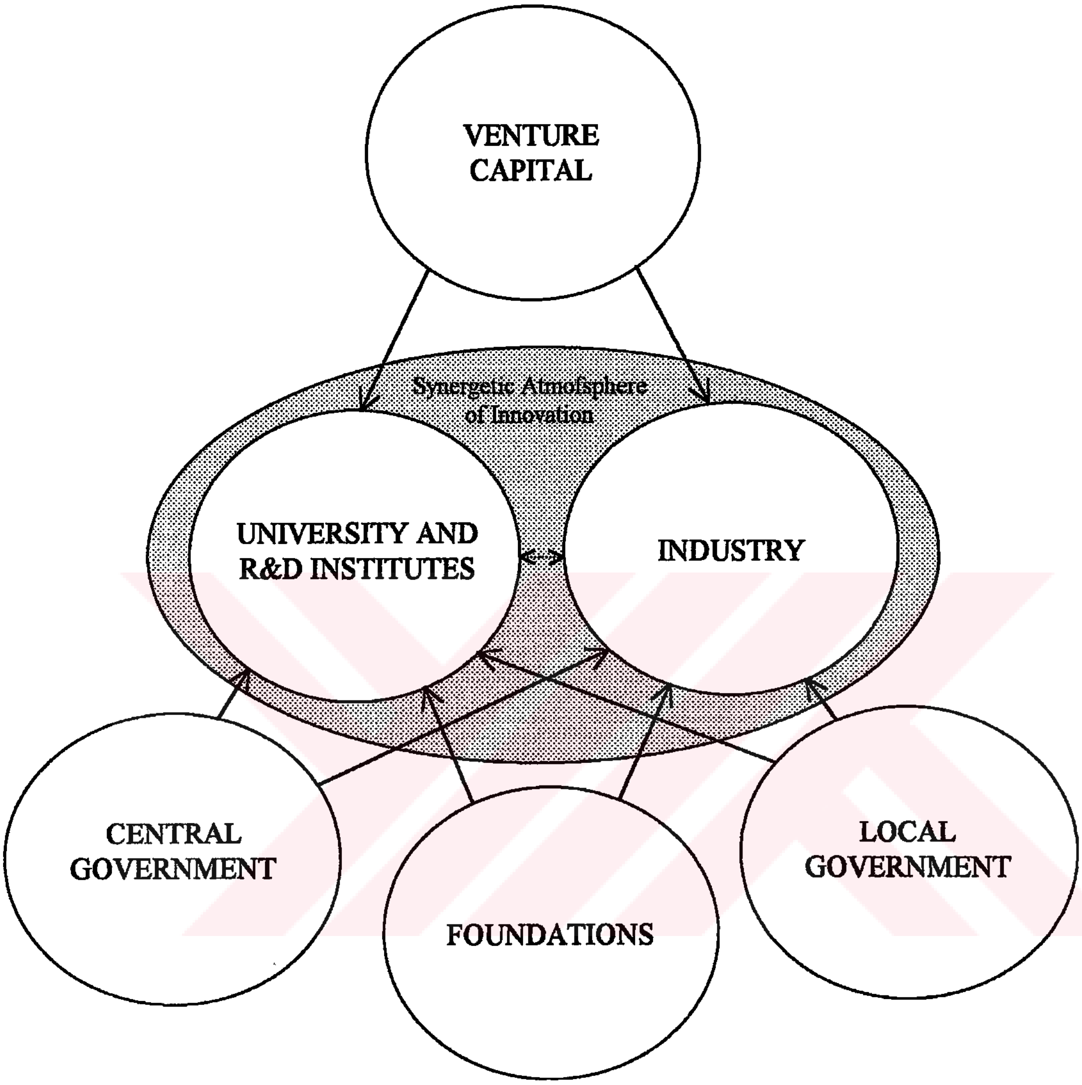

Figure 5 - Establishment of Relations Between Research & Development and Production.

Turkey, which is still under-industrialized compared with developed countries, is also under the effect of new global regulation created by the technological developments after the II World War. Globalization process has made it necessary for Turkey to adopt policies compatible with new competitive advantage. According to the 'Final Promissory Notes of GATT Uruguay Round', the results of R&D studies can not be copied and reproduced without the permission of owners of the idea. As patent rights have increased in importance, upgrading technology through copying original technologies has come under threat in developing countries and also in Turkey where in many firms industrial innovation is very low and generally firms upgrade their technology through either importing new production equipments or copying high-tech products imported from developed countries (Babacan, 1996: 22; Çorum and Konya Surveys (Table 23)). Firms copying technology are experiencing great difficulties in design process and prototype production as they are lack of necessary accumulation of experience and knowledge (Babacan, 1996: 22). They also experience great difficulties in business administration and marketing strategies as they can not assign special personnel to these issues (Göktepeli, 1995: 40-41). All these gave rise to efforts aiming at the creation of local high-tech base throughout the establishment of Technology Development-Transfer Centers and Technoparks.

In accordance with 'Final Promissory Notes of GATT Uruguay Round', in Turkey state intervention for high-tech regulation and constitution is minimized and standardized. It is only R&D aids through which state intervenes in the system but this does not mean that state can not be directly involved in high-tech constitution. High-tech Industrial Park of İstanbul-Pendik-Kurtköy (HTIPİPK), Technology Development Centers of Small and Medium Sized Industry Development Organization (TDCs of SMIDO) and Turkish Scientific & Technical Research Council - Marmara Research Center's Technopark (TSTRC-MRCT) can be considered as the high-tech districts where there is direct involvement of central government or its agencies.

High-tech incubation and production centers should be in close proximity with both industrial districts and universities. Turkish experience, however, shows a tendency, which is characterized by close spatial proximity of high-tech centers to universities rather than to industries. This is because of the fact that in Turkey as mentioned before it is predominantly universities which take active roles in high-tech constitution efforts and R&D studies rather than private sector (Table 17). That's why they are labeled as technoparks and technology development-transfer centers not exactly high-tech industrial districts.

Except for HTIPİPK, Technology Development-Transfer Center of Aegean Free Zone (TDTCAFZ) and Software Houses Free Zone Project (SHFZP), all other high-tech development centers are located within the boundaries of university campuses. Formally, only prototype production is allowed in these technoparks and mass production together with marketing activities are realized somewhere else. This shows the fact that in Turkey innovation is predominantly perceived as a linear path of development. Although linear model of innovation is generally employed in the incubation phase of high-tech development, parallel to this, it is necessary to develop and employ models of modern innovation theory if a sustained and matured high-tech development is to be realized. TDTCAFZ and SHFZP are relatively based on a concept that concerns the development of existing high-tech oriented firms. The real synergy in these two districts emerge as a result of the previously developed relations not as a result of the catalyst incubation center which is also helpful to the constitution of high-tech base in anyway.

When the goals set in the establishment of technoparks and technology development-transfer centers are considered, Turkish experiences fall between two extremes; on the one hand, most of the high-tech centers are designed mainly for the provision of consultancy services and their physical development area is very limited; on the other hand, some of the high-tech centers are characterized as being standalone towns having all the facilities provided by an urban environment (METU-Technopolis and TSTRC-MRCT).

Table 24 - Key Factors in Development of Turkish High Technology Communities.

HIGH-TECH DISTRICT	PROVINCE	Local Universities	State-provincial and local government policies	Federal government institutions and programs	Private sector activity - spin-off, venture-capital
HTIPİPK	İstanbul			●	
İTI	İstanbul	●	◑	◑	●
ATRP	Eskişehir	●		○	●
METU-SMIDO-TDC	Ankara	●		●	◑
İTU-SMIDO-TDC	İstanbul	●		●	◑
METU-Tech	Ankara	●		◑	◑
TSTRC-MRCT	İzmit	◑		●	○
TDTCAFZ	İzmir	○		◑	●
SHFZP	İzmit			◑	●

●-Critical; ◑-Very important; ○-Important

Source: Adapted from Steed and DeGenova; 1983.

Apart from this, high-tech industrial district constitution experience of Turkey can be categorized into four groups with respect to the source of the initiatives (Table 24). First group covers private sector led developments. TDTCAFZ, İTI and ATRP, which were established as incorporated companies responsible for the operation of their respective technology districts, together with SHFZP can be considered as the examples of the first group of technology centers (private sector led developments). Little state support is utilized in their constitution. TDCs of SMIDO constitute examples of the second group of high-tech developments created on the base of active involvement of universities in development of Technology Development Centers (university-government partnerships). METU-Technopolis which was supported by Technology Development Foundation of Turkey (TDFT) can be considered as an example of the third group of high-tech developments (university led developments). TSTRC-MRCT which was established by TSTRC and HTIPİPK which will be established by Undersecretariat of Defense Industry can be considered as the examples of the forth group of high-tech centers which are absolutely established and/or controlled by central government agencies (state led developments).

Table 25 - Prevailing High-Tech Constitution and Regulation Mechanisms in Turkey.

Regulation Mechanism	High-Tech Districts	Local Univer-sities	State-provincial and local government policies	Federal government institutions and programs (R&D included)	Private sector activity - spin-off, venture-capital
Developmental State Model (Interplay of Public and Private Sector Activity with Relative Dominance of Public Sector Involvement)	HTIPİPK, TSTRC-MRCT	○	○	●	◑
	TDCs of SMIDO	●	○	●	◑
Corporatist State Model (Interplay of Public and Private Sector Activity with Relative Dominance of Private Sector Involvement)	METU-Tech	●	○	◑	◑
	İTI, ATRP,	◑	◑	◑	●
	TDTCAFZ, SHFZP	○	○		

●-Critical; ◑-Very important; ○-Important

Turkish experience of high-tech creation exhibits an overlapping of regulation mechanisms of developmental and corporatist state models (Table 25). What is emerging from the analysis of Table 25 is again the fact that Turkish experience of high-tech development is based on the linear model of innovation. Of course the collaboration and cooperation between university and industry is a necessary one but it is not the only way of innovating. What is needed is the development of a system within which more tacit code of knowledge is produced and used. It is maybe at this point successful Organized Industrial Zones of Turkey are illustrative of how it is possible to build up a knowledge infrastructure conducive to innovations of all kind. But to highlight the innovation atmosphere prevailing in industrial zones is beyond the scope of this study although some references are possible. What follows is the case specific analysis of different kinds of high-tech development centers synthesized above according to the source of the initiatives.

4.2.1. Private Sector-Led Developments

İzmir Technopark Inc. (İTI)

İTI having 89 associates was established in the second half of the 1988 as a result of the collaboration realized between Ege University, Dokuz Eylül University, TSTRC, Aegean Chamber of Industry, Greater Municipality of İzmir, Association of Tradesmen and Small Craftsmen of İzmir together with participation of lots of industrial and financial organizations located in İzmir (İTAŞ, 1999b). The aims of İTI is as following: to solve the problems of industry and to find effective and economic solutions to the problems of industry; to make it possible for industry benefit from new technologies by sponsoring the research projects which can be commercialized and implemented successfully; to inform the researchers about the newest technological and scientific innovations realized all around the world by establishing relations with national and international science and technology institutes throughout their information networks; and to support small and medium sized firms by providing them with the results of scientific studies of R&D institutes (İTAŞ, 1999b).

İTI is located in the campus of Ege University. Currently 8 firms (2 firms having projects on bio-medical technology, 1 firm having R&D studies and production facilities on ion-implantation and 5 software developer firms) are located in the technopark and the priority is given to the projects developed in the following fields of technology and industry; food processing industry, textile, metallurgy, chemical industry and electronics (Interviews realized in İzmir, 1999 and İTAŞ, 1999a). Although the center has received lots of project proposals, because of the financial problems and limited physical area many of the projects have been only analyzed but not realized.

Among the firms supported by İTI, only one firm is very successful in commercializing his project (Interviews held in İzmir, 1999). Owner of the projects is a professor at Ege University. He first applied to TSTRC. In 1993, his project was accepted by TSTRC and later he applied to İTI. Currently, the firm is a joint venture established by owner of the project, İTI, TSTRC and TDFT. The firm provides its customers with ion-implantation processes (a state of art technical process).

Anadolu Technology Research Park (ATRP)

ATRP was established as an incorporated company as a result of the collaboration between Eskişehir Chamber of Industry, Rectorship of Anadolu University, two foundations of the University and 13 firms. ATRP provides firms only with consultation and education services. And it functions just like an incubation center having no physical barrier as it does not have a building or any necessary infrastructure (Babacan, 1996: 20). This model will be also employed by SMIDO in certain cities (İzmir, Kayseri, Adana, Bursa, Konya, Şanlıurfa, Gaziantep, Samsun, Denizli, Eskişehir and Gebze). The major aims of ATRP is as following (Pakpeşe, 1996: 65): to support entrepreneurship; to create and develop new high-tech oriented firms; to commercialize R&D investments; and in order to increase the variety of economic activities of Eskişehir to determine the researcher and expert potentials, to investigate the technologies developed or being developed by local producers, and to search and solve the technological problems of firms operating in Eskişehir

Aviation industry, Civil Aviation Education Center, Metallurgy Research Institute of Anadolu University, Medical Plant Research Center (MPRC) and MPRC's project of production of drug from medical plants, and bio-ceramics can be listed as the prevailing institutes, organizations and research projects operating in the park.

High-Tech Incubation and Development Centers of Free Zones and Organized Industrial Zones

The 'Turkish Free Zones'[48] Law No.3218, dated June 15, 1985, has paved the way for the constitution of an atmosphere within which Mersin and Antalya free zone projects were successfully completed by 1988 (Pakbeşe, 1996: 75). For these first two free zones expropriation of all the necessary land and construction of technical infrastructure were realized by the central government. The findings obtained from these experiences showed that expropriation of the land and construction of technical infrastructure can be realized by private sector's firms. Aegean Free Zone, which was put into operation in 1990, constituted the first example of the fact that construction of technical infrastructure of free zones can be successfully realized by private sector activity. Later, in 1991 İstanbul Atatürk Airport; in 1992 Trabzon; in 1995 in order of sequence, İstanbul Leather, Erzurum-Eastern Anadolu and Mardin; in 1997 İstanbul International Stock Exchange; and in 1998 again in order of sequence İzmir Menemen-Leather, Rize, Samsun, İstanbul Thrace and Kayseri free zones were put into operation.

The fact that free zones have favorable incentives and supports for industrial investments and operations realized within them attracted high-tech firms to free zones and consequently high-tech incubation centers have emerged within the boundaries of certain free zones. The Technology Development and Transfer Center (TDTC) which was established in Aegean Free Zone and Software Houses Free Zone Project which will be realized within the boundaries of Gebze Organized Industrial Zone can be considered as the first initiatives where technoparks and free trade zones overlap.

Technology Development and Transfer Center of Aegean Free Zone

Aegean Free Zone (AFZ) was established in 1990 by Aegean Free Zone Development and Operating Incorporated Company (Pakbeşe, 1996: 80-81). The original idea prevailing in the establishment of AFZ was to create a technology park where production based on high-technology would be realized. In accordance with this original idea, within the boundaries of AFZ, the construction of a Technology Development and Transfer Center began in March 1996 (Pakbeşe, 1996: 80-81 and Tuncer, 1997: 1). The center has been in service since July 1997 (Tuncer, 1997: 1 and Tuncer, 1998: 1).

In fact before the establishment of TDTC, Multi-user Business Center existing in AFZ was already functioning just like an incubation center (Pakbeşe, 1996: 80-81). However, in accordance with the original aim prevailing in the establishment of AFZ, the construction of an incubation and technology transfer center located on 4,000 square meters of land was realized in order to accelerate the entry of high-technology to Turkey. The incubation center is planned to attract firms operating in the fields of space technology and defense industry. TDTC serves as a facilitator for transfer of technology of space, industrial and military fields from leading western countries and progressive companies in the Zone (Pakbeşe, 1996: 80-81 and Tuncer, 1997: 1). Already some major firms producing high-technology military products have established production facilities on AFZ (Lockheed and Sikorsky) (Pakbeşe, 1996: 80-81 and Tuncer, 1997: 9). The objective of the establishment of TDTC is to create an incubation center for the production of high-tech products with introduction of technologies developed in Europe, Russia and especially USA (at NASA) to Turkey by employment of foreign experts, academicians and investors (Pakbeşe, 1996: 80-81 and Tuncer, 1997: 9).

AFZ Inc. provides the firms located in AFZ with municipal services together with lots of other services (food services, electricity, telephone, internet etc.). Bureaucracy has been minimized during application and operation phases by authorizing only one agency in charge of these procedures. In TDTC, only prototype production of high-tech products is allowed. Results obtained from R&D projects realized in the center will be available to entrepreneurs operating both in AFZ and other industrial districts of Turkey in order to make it possible for firms to realize production of prototypes. TDTC consists of a conference hall with a capacity of 250 people, a library, computer rooms and studios (ESBAŞ, 1998a: 7). Approximately 20 firms are expected to take R&D initiatives and another 20 firms are expected to take initiatives for pilot productions within the directions of R&D studies conducted at the center. In order to create and sustain a healthy innovation process, required technical, financial and administrative consultants will be invited to the center on a temporary base or they will be employed on a permanent base. Moreover, if the center becomes successful, similar centers will be also established in other parts of the region. Currently 4 firms are supported by TDTC of AFZ (Interviews held in İzmir, 1999).[49] Apart from these four firms, there are some other high-tech firms located in AFZ not in TDTC.[50] However, there is nearly no networking relation between high-tech firms located both in TDTC and AFZ (a finding emerged from the interviews held at AFZ).

TDTC has strong relationships with universities, R&D institutes and centers in close proximity. AFZ has collaboration agreements with Ege University (July 6, 1998) and Celal Bayar University (August 3, 1998) (ESBAŞ, 1998b: 5). Within the framework of collaboration protocol signed between Ege University and AFZ, on June 8, 1999 'AFZ Technopark Research Laboratory -1' has been put into operation within STIRC[51] (Science and Technology Implementation and Research Center) of Ege University (Interviews held in İzmir, 1999). In addition to this, within the framework of the protocol signed between İzmir High-Technology Institute (IHTI) and AFZ, firms operating in TDTC of AFZ will benefit from the laboratories of IHTI and all kinds of scientific facilities of IHTI will be available for high-tech firms operating in AFZ (ESBAŞ, 1998a: 7). Moreover, they want to apply to SMIDO for establishing a technopark within the boundaries of AFZ (Interviews held in İzmir, 1999).

Another project of Aegean Free Zone is the first Space Camp that will be activated within the AFZ in the summer of 1999 (Tuncer, 1997: 9 and Tuncer, 1998: 1). This will be the first Space Camp in Turkey and the seventh one in the world. It will encourage youngsters between the ages of 7 and 17 to explore their potential as future engineers, astronauts, scientists and educators through shuttle mission training, including simulation exercises, math, science, astronautics, and computer lessons.

Software Houses Free Zone Project

Another project that lies at the intersection of free zones and technoparks is Software Houses Free Zone Project (SHFZP). This project was developed as a result of the study which was sponsored by Administrative Board of Gebze Organized Industrial Zone (GOIZ) in collaboration with Turkish Knowledge Foundation and TSTRC-MRC (Pakbeşe, 1996: 80-81). The aim of the project is to make the constitution and development of successful software houses possible by agglomerating all the software developer firms and entrepreneurs together and providing them with necessary infrastructure (software library etc.) together with tax incentives available only in free zones (Pakbeşe, 1996: 80-81).

GOIZ has been in operation since 1990 and it has a high-quality infrastructure which is competeble with those only available in industrial parks of developed countries. Administrative Board of GOIZ have proposed the SHFZP which will be located on 40,000 square meters of land within the boundaries of GOIZ to General Directorate of Free Zones, Undersecretariat of Foreign Trade. The project in 1999 was still under investigation of Undersecretariat of Foreign Trade.

4.2.2. University-Government Partnerships

Technology Development Centers (TDCs) of Small and Medium Sized Industry Development Organization (SMIDO) constitute the examples of the high-tech incubation and development centers established throughout the university-government partnerships. Currently only in two centers (METU-SMIDO-TDC and İTU-SMIDO-TDC), some of the firms matured into successful commercial firms and left the centers (Table 26). Universities which have a TDC can be given as following; İstanbul Technical University (İTU), Middle East Technical University (METU), Ankara University (AU), Yıldız Technical University (YTU), Boğaziçi University (BU) and Karadeniz Technical University (KTU). As they resemble each other, only two of them having graduated firms are explained in some detail.

Table 26 - Technology Development Centers of SMIDO.

	İTU-TDC		METU-TDC		AU-TDC		KTU-TDC		YTU-TDC		BU-TDC		General Total	
Total Number of Modules for Use	23		29		11		9		9		13		94	
Area (m²)	2750		1099		320		250		360		860		5639	
Occupied Modules	16		24		10		6		4		9		72	
Occupied Modules (%)	70		93*		90		66		50		69		70	
Supported firms and projects up to now (according to years)	1991	1											1991	1
	1992	7	1992	7									1992	14
	1993	4	1993	8									1993	12
	1994	7	1994	4									1994	11
	1995	9	1995	5									1995	14
	1996	7	1996	7	1996								1996	14
	1997	11	1997	5	1997		1997	3					1997	19
	1998	10	1998	6	1998		1998	3	1998	7	1998	9	1998	45
	Total:	56	Total:	42	Total:	10	Total:	6	Total:	7	Total:	9	Total:	130
Graduated Firms (according to years)	1993	2											1993	2
	1994	2											1994	2
	1995	4											1995	4
	1996	12											1996	12
	1997	7	1997	11									1997	18
	1998	1	1998	3									1998	4
	Total:	28	Total:	14									Total:	42
Total Employment	185		87		18		14		17		19		340	
Firms not located in the center but supported by the center	11		27		1		-		3		-		42	
Status of supported firms (% of total)	Ltd.	57	Ltd.	96	Ltd.	90	Ltd.	50	Ltd.	71	Ltd.	78	Ltd.	81
	Inc.	33	Inc.	4	Inc.	10	Inc.	50	Inc.	29	Inc.	22	Inc.	19
	Founda.	5	Founda.	-	Founda.	-	Founda.	-	Founda.	-	Founda.	-	Foundation	
	Private	5	Private	-	Private	-	Private	-	Private	-	Private	-	Private	
Consultancy Support ($)	38,609		5,800				676		1,150				46,235	
Material Support ($)	59,671		105,000		50,800		15,220		4,574		1,438		236,703	
Patent Application	2		1		1		1		-		-		5	
Secured Patents	-		2		-		1		-		-		3	

* Because of the necessity more than one module is allocated to some firms.

Source: KOSGEB, 1998a and interviews held at METU-SMIDO-TDC.

Basic principles searched for admission of firms to TDCs are entrepreneurial skills, economic value and scientific and technological innovation. These centers are set up for the following purposes (Öz, 1995: 42): to support and sponsor technology-based entrepreneurship in a working environment possessing the infrastructure needed for knowledge-intensive production; to strengthen cooperation with the industry, within the structure of universities which are equipped with advanced computer and library facilities and can take an active part in the transfer of science and technology; to enable the transformation of scientific ideas into industrial production by securing economic exploitation of R&D efforts and supporting small and medium industries engaged in R&D; to create new jobs for skilled labor through new enterprises; to set up and develop innovative and knowledge-intensive enterprises creating high value added; and to implement new technological applications in small and medium industries.

METU-SMIDO-TDC

METU-SMIDO-TDC was founded as an incubator in association with Small and Medium Sized Industries Development and Support Organization. Collaboration protocol was signed between METU and SMIDO on May 2, 1991. The purpose of collaboration is to make it possible for firms to develop new products by employing the existing R&D infrastructure of METU. The center was put into service in April 1992 within the boundaries of campus of METU. It covers 4,500 square meters of land and currently (1999) 21 firms (predominantly electronics, computer hardware and software firms together with firms producing CAD/CAM products) are placed in the center. The center functions as an incubation area rather than an R&D center.

Firms are expected to pay a small part of the spendings done for consultation services and they pay no rent for the first six months (Göktepeli, 1995: 44). In the center, in order to develop national industry, entrepreneurs aiming at the development of new products and technologies are given the opportunity of benefiting from the services provided by the center and the university. These services are explained and listed in the next section. So far as 14 firms have left the center. Some of them have been very successful in commercializing their projects (ORTANA Ltd. and GATE Inc.). A further discussion of functionality of TDCs by focusing on METU-SMIDO-TDC case is available in the next sections.

İTU-SMIDO-TDC

İTU-SMIDO-TDC is a product of protocol signed between İTU and SMIDO. Collaboration protocol was signed on October 8, 1991. The center, like METU-SMIDO-TDC, functions as an incubation area for the development of technology oriented firms. The center collects the newest information and informs the firms about the new innovations and high-technology products. It covers 20,000 square meters of land at Ayazağa Campus of İTU. The priority is given to the following fields of industry; electronics, computer hardware and software firms together with firms making production in the fields of robotics technology. One of these firms is İTU-ETA Foundation's Application Oriented Integrated Circuits Design Center, which is co-established by five major electronics firms of Turkey (Teletaş, Netaş, Vestel, Beko and Siemens).

Firms are expected to meet only 15% of the all spendings made by the center for consultation services. Moreover, being different from METU-SMIDO-TDC, for the projects approved by the center, 25,000 US dollars are paid by the center to the firms for the realization of prototype production. This cost is repaid by the firms within 4 years following the commencement of operations of firms and under very suitable conditions. The center currently (1999) gives special support to 16 firms (Interviews held at İTU-SMIDO-TDC and SMIDO, 1999). Moreover, so far as supported 28 firms one of which produce the first robotic project of Turkey left the center.

In both centers of technological development, METU-SMIDO-TDC and İTU-SMIDO-TDC, entrepreneur firms are supposed to incubate in 3-4 years and then leave the centers when they are matured into successful innovative high-tech firms. Thus, these centers rather function as high-tech incubation areas. The completion period of the projects which are accepted and approved by the center can be prolonged to 5 years.

4.2.3. University Led Developments

Middle East Technical University Technopolis

The studies on METU-Technopolis[52] Project started in 1987 with seminars clarifying the issue. In 1988, Science Parks in United States were investigated and the observations were presented to the University, public and industry. A pre-feasibility study was prepared in the same year. In 1989, UK Science Parks were visited and a concept design was developed according to these experiences. In 1995, Ankara Business and Science Park Feasibility Study

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was started to be prepared by an international consulting firm. This project was also supported by TDFT and according to the result of the study which was completed in May 1996, METU-Technopolis Project has been reported as feasible. In the same year, METU-Technopolis Executive Board was established and the attempts for founding Technopolis have been continued officially.

In 1997, METU Campus and Technopolis Regional Design Project was prepared by the members of METU Department of City and Regional Planning. All architectural, infrastructural and environmental features are examined in this study in a framework of different development plans for METU-Technopolis. When the whole project is completed, it will cover 210 hectares of land besides the development area of METU. Technopolis project will consists of three parts; 'science park'[53], 'business park'[54] and 'settlement area'[55]. Moreover, a Business Development Plan was presented by the members of METU Department of Management, investigating the possible alternatives of Technopolis administration. In accordance with the principles defined by the documents above, the foundation of the first building of Science Park was laid in June 1997. This building will have several offices with a total closed space of 5000 m^2 and the half of the offices will be used by the tenant software company while the remaining half will be leased to other software companies which are eligible to take place in the technopark. In addition, detailed projects of the second building of METU-Technopolis, called METU Twins, was completed by the end of 1997.

METU-Technopolis Project has been accepted as among the most preferred projects in science and technology by State Planning Organization of Turkey. With this priority, an authorization for foreign credit was given by Turkish Treasury and the Project will be adjudicated internationally by the help of this credit. With the beginning of 1998, METU-Technopolis Development Board has been established in order to develop new proposals revising the previous studies on Technopolis project. Members of the Board are from the University, public institutions and the industry of the region.

Main goals of the Technopolis is as following: supporting the formation and development of high-tech using/producing firms; ensuring the development of technology; providing the support and space in which the firms performing in the area can apply their studies; maximizing the university-industry cooperation; enabling the transformation of the results of university research into economic values; contributing the improvement of international competitive power of the country by way of strengthening the economic and technological level; and employment of developed labor power and infrastructure of the university in creation of the economic value.

Applications for tenancy have been evaluated by METU-Technopolis Technical Commission. Specific services that are provided by METU to the outsiders will be served at a discount to Technopolis tenants: Tests and Experiments, Computer Center Services and Continuous Education Programs. In addition, a certain amount of costs of consultancy services offered by the members of the University or that of applied research projects performed by the University will be deducted from rents of tenants. ITERI[56] (Information Technologies and Electronics Research Institute) of TSTRC located in the campus of METU attract also high-tech firms to nearby METU-Tech and METU-SMIDO-TDC sites. Only following high-tech and information intensive activities are eligible for application to METU-Tech; Biotechnology, New Materials Technology, Robotics and Mechatronics, Micro-electronics, Information Technologies, Expert Systems, Business Administration and Consultancy, Software Development, Telecommunication Technology, New Value-Added Services, Geographic Information Systems, Technology Evaluation, Artificial Intelligence and Operational Analysis.

4.2.4. State Led Developments

High-tech Industrial Park of İstanbul-Pendik-Kurtköy (HTIPİPK)

The provisions of the Council of the Ministers' Decision 88/12902 of 20 April 1988 within the direction of Decisions of the Execution Committee of Defense Industry (on September 8, 1987 and on March 19, 1988) paid the way for the establishment of HTIPİPK (Pakpeşe, 1996: 58-59). For this purpose, Undersecretariat of Defense Industry was given the responsibility of establishing a high-technology industrial park in İstanbul-Pendik-Kurtköy. Undersecretariat of Defense Industry was responsible from the coordination between related government agencies for the establishment and operation of the park (expropriation of the necessary land, provision of infrastructure and building of an airport).

The objectives of the project is as following (Pakpeşe, 1996: 58-59): to create an innovation atmosphere which produces and commercializes high-tech products in the fields of electronics, air-craft engineering and defense industry for the national industrial and scientific potential; to contribute into national economy and to provide industry with creative synergies; and to transform the region of İstanbul-Pendik-Kurtköy into a center of high-tech innovation and incubation.

In accordance with these objectives, 13 Million square meters of land of which 4.6 Million square meters was assigned as Free Trade Zone was expropriated by General Directorate of Land Office for Undersecretariat of Defense Industry. After that, on April 11, 1991, Undersecretariat of Defense Industry formed an international team for the preparation of feasibility analysis and design of master plan of HTIPİPK. On August 9, 1991, the preliminary feasibility report of the project realized in collaboration with related public organizations, universities and R&D institutes, on December 21, 1991 the final feasibility report and on July 6, 1992 Strategic Plan Report was completed and presented to Undersecretariat of Defense Industry. However, later the project was not improved and all the studies related with the project was postponed.

TSTRC - Marmara Research Center's Technopark (TSTRC-MRCT)

Marmara Research Center (MRC)[57] has undertaken the preparatory work to establish a Technopark at its site in Gebze by the Sea of Marmara, half an hour drive from the center of İstanbul through the highway. Master Plan for the technopark area was completed at the end of 1995. Although TSTRC-MRCT is located within the boundaries of TSTRC-MRC, it does not have an independent technopark building (Interviews held at MRCT, 1999). Compared with the other technoparks, a different strategy was employed in the establishment of the park. At the beginning tenant entrepreneurs were attracted to the park site by assignment of a small part of laboratories and offices of MRC as the research facilities of the technopark in October 1992.

Technopark/innovation center has been in operation and currently 8 firms are located in TSTRC-MRCT in accordance with TSTRC Law (Law No.278) and related regulations (Interviews held at MRCT, 1999). The goal of the establishment of the technopark is to provide small and medium sized entrepreneurs and industrialists with technological support and free use of technological infrastructure of TSTRC-MRCT in order to make the incubation and development of environment friendly high-tech firms possible. The validity period of operation license is maximum three years for tenant firms and no activities based on mass-production are allowed on the technopark. Within the framework of 'royalty agreements', firms located at TSTRC-MRCT utilize the R&D personnel and laboratories of MRC. After the commercialization of the project, according to ratio specified in the agreement (generally 5%), a small part of the profit is paid to TSTRC (Interviews held at MRCT, 1999). This payment continues for a period of time specified in the agreement (generally 5-7 years). Currently, there are five firms graduated from the technopark. TSTRC-MRCT is also planned to have a free zone status. They have applied to the Undersecretariat of Foreign Trade in order to make it possible for firms to use the incentives of free zone (Aksoy, 1999 and Interviews held at MRCT, 1999).

When wholly completed, MRC-Technopark will cover 56 hectares of land with an employment capacity of approximately 3500 people. MRC-Technopark will be mainly composed of a modern Residential Section capable of housing up to 4000 people, an Innovation & Administration Center, Technology Buildings where research and pilot production will be undertaken in major high technology areas (Information & Communication Technologies, Advanced Materials Technologies, Biotechnology, Environmentally Friendly Technologies and Flexible Production Technologies) and Social Facilities (Hotels, Cafeteria, Kindergarten, Health Center, Social Center and open sports facilities). Among the strategic design principles of the Technopark are wide green belts covering minimum of 25% of the technopark and residential areas; low buildings with maximum heights of three stores and, high parking standards. Currently, a TDC which will accommodate 40-50 high-tech firms is under construction (Interviews held at MRCT, 1999). It will facilitate the spatial agglomeration of the firms (currently firms are scattered all over the park buildings where there is empty modules).

The MRC-Technopark project will be undertaken by a company to be established with shareholders both from the local and foreign private sectors alongside TSTRC. This company will have shares for both the Technopark and the Residential Section and will also manage the Technopark. As such, the investment and management model will be the first of its kind in Turkey. The companies who choose to be located in the Technopark will lease or buy their land and construct their buildings in accordance with accepted architectural standards.

4.3. Industrial and High-Tech Regulation Mechanism in Turkey

4.3.1. Main Actors of Industrial and High-Tech Regulation Mechanism

In Turkey, main actors of industrial and high-tech regulation mechanism can be analyzed in four different levels. First level covers the central state institutions responsible for the determination and implementation of basic principles of incentive system and encouragement schemes. These central state institutions are General Directorate of Incentive Implication (GDII), General Directorate of Foreign Investment and General Directorate of Exports (GDE). GDII is responsible for implementation of investment incentives determined by the Undersecretariat of Treasury and GDE is responsible for implementation of export incentives determined by the Undersecretariat of Foreign Trade. The general structure of the incentives provided within this framework is given in the next section under the headings of 'State aids for investment' and 'State aids for export oriented activities'.

Second level covers the central state institutions responsible for the development of national industry. This institutions are General Directorate of Free Zones (GDFZ) and General Directorate of Industrial Districts and Estates (GDIDE) together with Small and Medium Sized Industries Development Organization (SMIDO). GDFZ is responsible for the establishment of Free Zones (FZs). GDIDE is responsible for the establishment of Organized Industrial Zones (OIZs) and Small Industrial Estates (SIEs). SMIDO is responsible for the establishment of Technoparks and development of small and medium sized entrepreneurs (SMEs). Incentives provided within FZs, OIZs and SIEs together with the ones provided for SMEs are also given in the next section.

Third level covers functionally mediator institutions. They are Technology Observation and Evaluation Organization of Turkish Scientific and Technical Research Council (TOEO of TSTRC), Technology Development Foundation of Turkey (TDFT) and Universities. All of these institutions depend upon the rules set down by Undersecretariat of Foreign Trade and National Treasury together with the Ministry of Industry and Trade. These institutions rather function as technical consultants in the provision of incentives generally determined by other organizations. The regulation mechanism prevailing in the establishment of technoparks are considered in relation to the legislation about them in the next sections.

Forth level covers banks providing high-tech firms with venture capital and credits. Development Bank of Turkey is just a mediator institution for the R&D support provided by the Undersecretariat of National Treasury. On the other hand, Vakıf Risk provides high-tech firms with venture capital. Halk Bank is both a mediator institution for the R&D support provided by the Undersecretariat of National Treasury and has also its own low interest credits for young entrepreneurs; 'Young Entrepreneur Credit of Halk Bank'. Other commercial banks have no special support schemes for high-tech firms and provide them only with credits at normal interest rates.

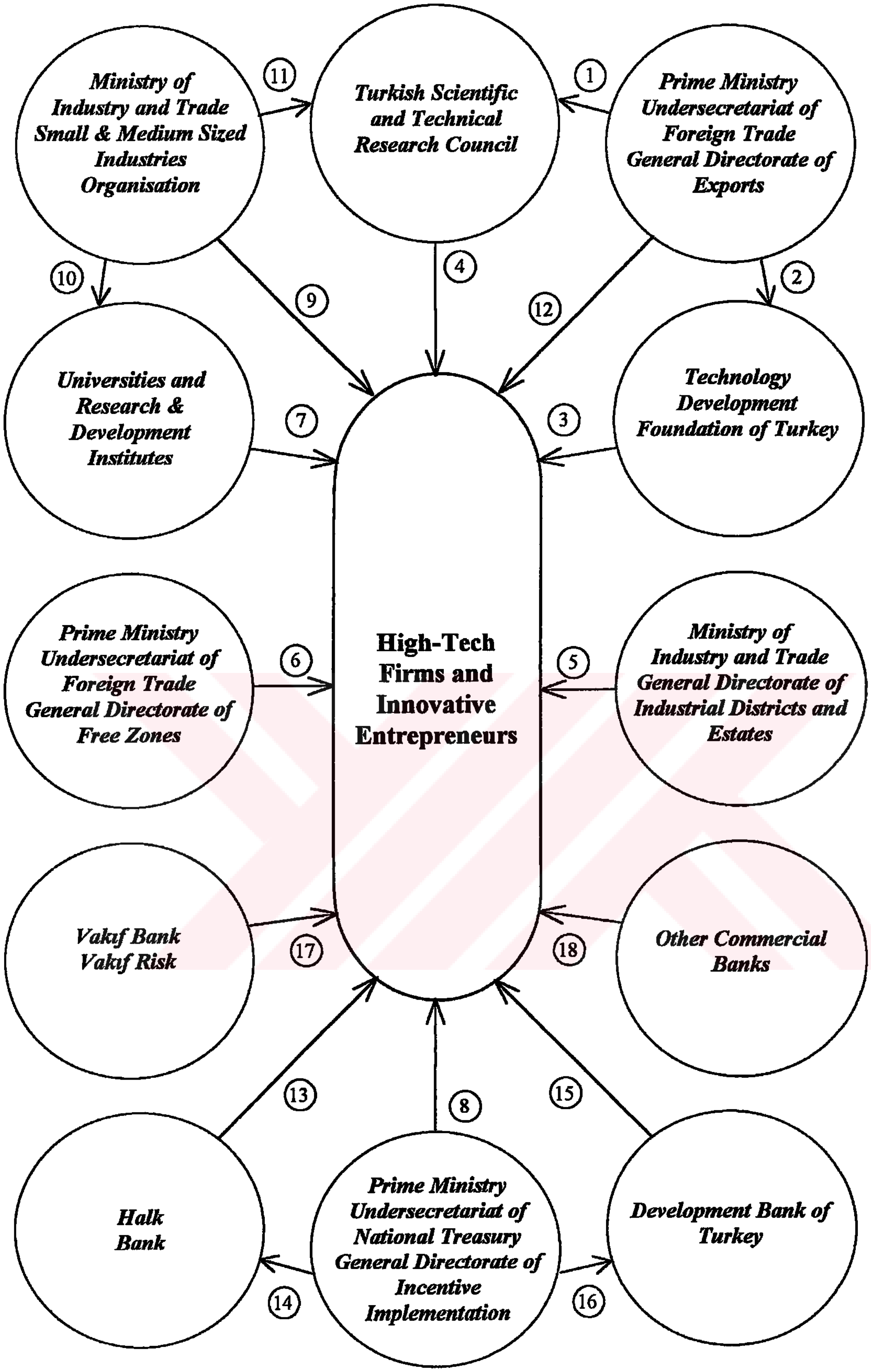

Figure 6 - Actors of High-Tech Industrial Incentive System and Encouragement Schemes.

4.3.2. Incentive System and Encouragement Schemes in Turkey

Becoming a signatory to GATT (General Arrangement on Tariffs and Trade) agreement exposed Turkey to external pressure to liberalize and deregulate its own economy (Duran, 1998: 23-30). In accordance with the rules set down in Final Promissory Notes of Uruguay Round, signed in April 1994 and came into force in 1995, in Turkey the direct monetary aids which had been available for investment and export activities have been replaced by standard state incentives and encouragement schemes which are designed according to the international norms. Moreover, in 1996 the removal of custom barriers between Turkey and European Union (EU) has made it necessary for Turkey to review and redefine its legislation system related with customs in accordance with the legal system of EU.

Within this framework, incentives and encouragement schemes provided for firms can be analyzed under 5 different categories; State Aids for Investments, State Aids for Export Oriented Activities, Free Zone Incentives, Organized Industrial Zone and Small Industrial Estate Incentives, and Incentives and Encouragement Schemes of SMIDO. General finding is that although it is only high-tech firms who are given special importance in State Aids which directly affect all other incentive systems and encouragement schemes, there is no significant improvement in the constitution of these firms.

4.3.2.1. State Aids for Investments

The Turkish incentive system for investments (Arrow 8 on Figure 6) can be classified under four main headings: General Incentive Regime; Incentives Granted to Small and Medium Sized Enterprises; Incentives Granted to Less Developed Regions; and Incentives Granted Especially to R&D Activities.

To benefit from all these types of incentives, local and foreign investors are equally treated; the foreign capital companies can benefit from all incentives and allowances granted to local companies. This equal treatment is guaranteed by the law No.6224 and Treaties for the Reciprocal Protection and Promotion of Investments. In order to qualify for investment incentives, the foreign investors must receive an incentive certificate from the General Directorate of Foreign Investments (GDFI).

General Incentive Regime

The current legislation concerning the investment incentives is shaped by the decree published at 25th of March 1998, and its related communiqué published at 6th of May, 1998. According to this legislation, the incentive tools granted to investors are exemption from customs duties and fund levies, investment allowance, Value Added Tax (VAT) deferral for imported and locally purchased machinery and equipment, and exemption from taxes, duties and fees.

The incentive measure designed for exemption from customs duties and fund levies ensures that the imported machinery and equipment for the investment can be brought to the country with the exemption of customs duties and fund levies (exemption from Customs Tax and the Mass Housing Fund paid in accordance with the Decree on Import regime)[58]. The machinery and equipment which are to be imported under this measure must be included in the import machinery and equipment list to be approved by GDFI. Within this context, raw materials and intermediate goods cannot be imported.

Investment allowance is a corporate tax exemption applied to taxpayers. Of the expenses incurred within the scope of investment incentive certificate, those relating to buildings, machinery, equipment, freight and installation are entitled to benefit from the investment allowance. The current allowance rate is 100%, which means that an amount equal to the fixed investment cost can be deducted from the future taxable profits. Investment allowance amounts are also entitled to readjustment for inflation.

VAT deferral for imported and locally purchased machinery and equipment means that the Value Added Tax, which is due to be paid for both the imported and locally purchased machinery and equipment, shall be deferred by this incentive measure. The imported machinery and equipment, which are included in the import machinery list approved by GDFI, can be brought to Turkey without paying Value Added Tax. The locally purchased machinery and equipment should also be included in the locally purchased machinery list to be approved by GDFI. With this approved machinery list, the investor can purchase the local machinery without paying the VAT to the seller.

Lastly, the investors who commit to realize 10.000 US Dollars of exports upon the completion of the investment are granted exemption from the 'taxes'[59], duties and fees related to; establishing a company, increasing capital within the investment period, receiving investment credits whose terms are at least one year, and registration of land and properties as capital-in-kind.

The general incentive regime is applied varying to the location, scale and subject of investments. In terms of application of general incentives, Turkey is divided into three types of regions: Developed Regions (Provincial boundaries of İstanbul and Kocaeli; and the Greater Municipality boundaries of Ankara, İzmir, Bursa, Adana and Antalya), First Priority Regions (50 cities determined by the Council of Ministers: Adıyaman, Ağrı, Aksaray, Amasya, Ardahan, Artvin, Bartın, Batman, Bayburt, Bingöl, Bitlis, Çanakkale, Çankırı, Çorum, Diyarbakır, Elazığ, Erzincan, Erzurum, Giresun, Gümüşhane, Hakkari, Iğdır, Kahramanmaraş, Karabük, Karaman, Kars, Kastamonu, Kırıkkale, Kırşehir, Kilis, Malatya, Mardin, Muş, Nevşehir, Niğde, Ordu, Osmaniye, Rize, Samsun, Siirt, Sinop, Sivas, Şanlıurfa, Şırnak, Tokat, Trabzon, Tunceli, Van, Yozgat and Zonguldak) and Normal Regions (Provinces situated outside of the Developed Region and First Priority Region classifications).

The above incentive measures are applicable for all types of investments in the normal and first priority regions together with investments in the Organized Industrial Zones determined by the Ministry of Industry and Trade, and investments to be realized by enterprises which fall under the definition of SMEs, but only the following investments can be qualified for incentives in the developed regions: electrical energy production investments (including "autoproduction" investments); infrastructure investments; investments to be realized within the framework of the Build-Operate or Build-Operate-Transfer Models; **investments aimed at developing a new product or model, Research and Development (R&D) and planning; investments related to environmental protection; priority technological investments which are determined by the High Commission of Science and Technology; electronics industry related investments**; ship and yacht building investments; shipyard investments (Shipbuilding, and repair facilities); other, 'services investments' which are to be determined by the Undersecretariat of Treasury, including; **technoparks, informatics technology, education, health and tourism investments**; investments that are permitted by the Undersecretariat of Treasury in order to replace existing investments which are to be transferred to the Priority Development Regions or outside the country, with the condition that, the realization of the new investment is at the same place of the one being transferred; expansion, modernization, renewal, quality upgrading, bottleneck elimination, integration, and completion investments; and **investments to be permitted by the Undersecretariat of Treasury, among the investments completely new with a fixed investment value of above 50 Million US Dollars and include one or more of the following characteristics:**

necessitating high technology, high added value, contribution to an increase in tax income and contribution to an increase in employment.

To be eligible for these incentive measures, the minimum amount of fixed investment must be 50 billion TL for the normal and developed regions, and 25 billion TL for the first priority regions, together with the following minimum equity rates:

Type of investment	**Minimum equity rate**
Investments in the first priority regions	20%
Investments in the normal and developed regions	40%
Ro-Ro and air cargo transportation	25%
Boat and yacht construction or boat and plane imports	15%
Investments held by the leasing companies	10%

Incentives granted to Small and Medium Sized Enterprises (SMEs)

The incentives relating the Small and Medium Sized Enterprises (SMEs) is governed by the Decree (Decree numerated 99/12474 and dated 19.02.1999) published in the official gazette at 5th of March, 1999. By this Decree, a SME is defined as an establishment operating in manufacturing sector, employing at most 150 workers, and utilizing capital goods (machinery, equipment, vehicles and office stock - excluding land and buildings) of not more than 100 billion TL registered in the legal books. The aim of this Decree is the protection and promotion of SMEs, improving their production and quality standards and enabling them to develop new products.

The incentive measures applicable to SMEs are as follows: exemption from customs duties and fund levies; investment allowance; VAT (Value Added Tax) deferral for imported machinery and equipment; VAT refund for locally purchased machinery and equipment; exemption from taxes, duties and fees; subsidized credit facility both for investments and operations (available only for the procurement of the imported machinery and equipments together with procurement of raw materials except for electricity); and Halk Bank credits for SMEs both for investments and operations (Arrow 13).

The application procedures of the first five incentive measures is identical with the general incentive regime. The sixth measure, subsidized credit facility, is a fund-sourced credit to finance machinery, equipment and raw materials for the investment project. The terms and conditions of the credit facility is summarized in Table 27 (for investment credits for the first year, there is no repayment).

Iğdır, Kahramanmaraş, Kars, Kilis, Malatya, Mardin, Muş, Ordu, Rize, Siirt, Sinop, Sivas, Şanlıurfa, Şırnak, Tunceli, Van and Yozgat. Those provinces are given priority for the utilization of subsidized credit facility.

Table 27 - The terms and conditions of subsidized credit facility provided for SMEs.

	Priority Support Regions	First Priority Regions	Normal and Dev. Regions
Maximum amount of investment credit	75 billion TL	60 billion TL	50 billion TL
Maximum amount of operating credit	25 billion TL	25 billion TL	25 billion TL
Interest on credits (%)	20	20	30
Minimum equity ratios (%)	10	20	30
Max. terms of the investment credits	4 years	4 years	4 years
Max. terms of the operating credits	2 years	2 years	2 years

Source: Undersecretariat of Treasury, Prime Ministry.

The other key features of SME incentive regime are as following: the maximum amount of the investment project should be 100 billion TL; raw materials for the project can be included in the investment certificate; Investors are exempted from the amount deposited in the Central Bank; the investment should be completed within six months but this period can be prolonged to 15 months; the application should directly be made to Halk Bank (a public bank mainly responsible from the financing of small entrepreneurs) (Arrow 14).

Incentives Granted to Less Developed Regions

To restore the interregional development level differences and create employment in less developed regions, some extra incentive measures have been taken. These incentives can be summarized as;

Corporate and Income Tax Exemption: The law No.4325 dated 21.01.1998 brings in important tax exemptions for the for the new businesses established between 01.01.1998 and 31.12.2000 for the following cities: Batman, Bingöl, Bitlis, Diyarbakır, Hakkari, Mardin, Muş, Siirt, Şırnak, Tunceli, Van, Adıyaman, Ağrı, Ardahan, Bayburt, Erzurum, Gümüşhane, Iğdır, Kars, Ordu, Şanlıurfa and Yozgat. These establishments are exempt from corporate and income taxes for a period of 5 years from the beginning of operations provided that they employ at least 10 workers. This incentive does not require an incentive certificate.

Energy incentives: The legislation governing energy incentives has been published at the official gazette dated 24.10.1997. This incentive measure enables the investors to benefit from a 50% reduction in their electricity expenses within the following city boundaries: Van, Diyarbakır, Siirt, Tunceli, Şırnak and Hakkari. This incentive shall be applied during the validity of the incentive certificate.

Land Allocation: The Law No.4325 also provides free land allocation for the investments in first priority regions. This incentive requires at least 10 jobs to be created and an incentive certificate to be taken. Land allocation applications shall be evaluated according to the availability of publicly owned lands in the investment location.

Incentives Granted Especially to R&D Activities

Within the scope of 'Decree Concerning State Encouragements to Investments and the Investment Encouragement Fund', Investment Encouragement Fund (IEF) has been created. In accordance with the legislation relating to Government Encouragements for Investments, credits can only be allocated in order to encourage, and address investments to be made in accordance with the limits set forth by the Undersecretariat of Treasury for investments in; Research and Development (R&D), technoparks, environment protection, priority technology investments which are determined by the High Commission of Science and Technology, and SME's.

The amount, duration, and interest rates along with other measures of implementation and application for credits to be allocated from the Fund shall be set by the Undersecretariat of Treasury. Transfers to be made to intermediary banks and related authorities and institutions in connection with the Investment Encouragement Legislation will be executed on the basis of the date of arrival of the applications to the Undersecretariat of Treasury. The Undersecretariat shall establish the rules and guidelines relating to the credit allowance from the Fund, selection of the intermediary banks and any other institutions, system of the credits and payments (interest rates and termination dates included).

Since the official communiqué has not been yet published in the Official Gazette, currently no credits are available for high-tech firms from IEF (1999). In addition to this, it is also impossible to give any R&D credit from the fund within the framework of previous decree and its related communiqué (for the credits given within the framework of previous decree, intermediary bank was Turkish Development Bank (Arrow 15 and 16)). Thus, those firms who want to apply for the credits provided from IEF should wait the publication of the official communiqué.

4.3.2.2. State Aids for Export Oriented Activities

The purpose of 'Decision About State Aids for Export Oriented Activities'[60] (Decision No.6401 for the year 1994) is to provide firms with the support of state in accordance with the norms of World Trade Organization (WTO) in order (Arrow 12); to prevent the economic and social problems emerged as a result of the uneven regional development; to increase employment opportunities by increasing education facilities; to support R&D activities of sectors and firms which are export oriented and especially producing new products, new production systems and technologies; to organize small and medium sized firms making production within the same sector; and to solve the environmental problems of national industry and to increase the export potential of national industry by introducing national products for export into international markets through advertisements and so on.

This general decision was followed by a series of 'Decisions of Money-Credit and Coordination Council', dated June 1, 1995 (Renda, 1995: 54, Pakbeşe, 1996: 67, TÜBİTAK, 1997: 3 and KOSGEB, 1999). Among these decisions, 'Communiqué About R&D Aids' (Communiqué No.2 for the year 1995) is composed of 2 sections and developed as a result of the collaboration of Undersecretariat of Foreign Trade with TSTRC and Technology Development Foundation of Turkey (TDFT). The objective of this decision is to provide R&D projects with financial aids (Pakbeşe, 1996: 67). This decision was modified by the decision (Decision No.16 for the year 1998) of Money-Credit and Coordination Council but the basic structure of the decision which is mentioned above was not changed. According to the last decision and its related communiqué published in the official gazette at 4th of November 1998, R&D activities are supported as following;

The evaluation and selection of projects in the first section is realized by TSTRC (Arrow 1 on Figure 6). In the first section, R&D activities eligible for state support are as following; concept development and feasibility studies for both in-house and external R&D activities; transfer of conception into design in laboratories; design and drawing studies for prototype production; establishment of pilot plant and prototype test production; patenting and licensing activities; and market and after market consultation services.

The financial support provided for these activities can not exceed 60% of the total R&D spendings and a project can be supported up to (at most) 3 years (TÜBİTAK, 1997: 3-8 and Official Gazette No. 23513, dated November 4, 1998). According to the communiqué, R&D

support is available for followings; all the spendings done for scientists, engineers and technicians; procurement of necessary R&D equipments, devices and their software; R&D consultation services; all the payments made to universities, TSTRC and private R&D laboratories for their R&D studies necessary for the project; all the expenditures done for patent or utility model applications and related services of Turkish Patent Institute; and procurement of equipments which will be directly used in R&D activities.

The basic R&D support is at most 50% of the total R&D spendings. If the project result in a granted patent, then 10% of the R&D spendings done by the firm is paid back to the firm. In addition, financial support provided can be increased by 20% if R&D activity covers the following fields; informatics, flexible production and/or automation technologies, new materials, genetic engineering, bio-technology, space and aviation technologies. For the eligible projects, personnel spendings are supported at ratios given as following; 60% for large firms; 75% for small and medium sized firms; 90% for firms operating in TDCs, Technoparks or similar centers; and 100% for the personnel having philosophy degrees. If R&D activities are realized within the boundaries of a technopark or subcontracted to universities and/or TSTRC, then financial support provided for R&D activities can be increased by 30%. For the projects which are successfully commercialized, the financial support can be increased by the ratios given as below;

Revenue obtained from the sale of product developed as result of the project / Total revenue from all sales	Ratio by which the financial support can be increased
0%-25%	10%
25%-50%	15%
50%-100%	20%

The evaluation and selection of projects in the second section is realized by TDFT (Arrow 2). Supported R&D activities are development of new products having high commercial value, development of the competitiveness of existing products on the market by employing new production methods-technologies and Strategic Focal Topics. The financial support provided for these activities can not exceed 50% of the total R&D spendings. In the second section, firms having projects concerning R&D activities can be given at most 1 Million US dollars of credit for 2 years of period (Renda, 1995: 53 and Official Gazette No. 23513, dated November 4, 1998). Financial support given to the projects within the framework of both first and second sections are met by the Central Bank of Turkey from 'Fund of Support and Price Stability'. Although the financial support provided within the framework of the first section (TSTRC) is not paid back by the firms, according to the communiqué firms which are given financial support within the framework of second section (TDFT) should pay back the amount of financial support they have used for their R&D activities to the fund (Official Gazette No. 23513, dated November 4, 1998: 40).

In addition to the R&D supports mentioned above, TDFT has another financial resource in order to support R&D projects. TDFT was established on June 1, 1991, as a result of the collaboration between public and private sectors of economy within the framework of a World Bank (WB) project which was realized in the direction of an agreement signed between WB and Turkish Republic (TDFT, 1995: 1 and Akbaba, 1994: 63-64). TDFT has a 43.3-Million-US-dollar-fund provided by Undersecretariat of Treasury and WB for Technology Development Project (Akbaba, 1994: 63-64) (Arrow 3). In addition to this, TDFT has also a 20-Million-US-dollar-fund provided within the framework of 'Montreal Protocol Multilateral Fund' for 'Reducing the Usage of Chlorofluorocarbons (CFCs) and Other Ozone-Depleting Substances'.

Within the framework of Technology Development Project, total 190 projects have been proposed to TDFT since 1992 and 57 of them have been supported by TDFT (1996). The total amount of financial support given to these projects is 16 Million US dollars. When the contributions of the firms themselves are added to the financial supports of TDFT, amount of money spent on these R&D projects totals about 36 Million US dollars.

Decisions about processing in Turkey and abroad (Decision About Processing in Turkey (Decision No.7615 for the year 1995) and Decision About Processing in Abroad (Decision No.7617 for the year 1995)) provides firms with some other incentives (Arrow 12). These incentives which aim to facilitate the production of export products and products involving necessarily a process realized in foreign countries are exemption from customs duties and fund levies for the imported intermediate goods and raw materials which will be used for the production of products which will be exported, repayment of customs duties and fund levies paid for the imported intermediate goods and raw materials in the case of verification of the fact that these intermediate goods and raw materials are processed in Turkey and then exported, and exemption from customs duties and fund levies for the imported products which was produced necessarily in foreign countries by using the intermediate goods and raw materials originally produced in Turkey (İhracat Genel Müdürlüğü, 1998).

4.3.2.3. Free Zone Incentives

Free Zone operator and user firms can benefit both from the incentives provided within the framework of the 'Turkish Free Zones Legislation and Regulation' (Arrow 6) and from the

... and ... for free ... can be given as below (Department of Promotion and Research, 1996):

Legislative provisions pertaining to taxes, levies, duties, and to customs and foreign exchange obligations are not applicable in free zones. Goods and services produced in free zones are also exempted from value-added tax. Income and revenues generated in the free zones through activities of real persons and legal entities with full or limited tax liability in Turkey, are exempted from income and corporate taxes, provided that the transfer of such income and revenues into Turkey is documented pursuant to foreign exchange regulations. Free zones earnings and revenues can be transferred to any country, including Turkey, freely without any prior permission and are not subject to any kind of taxes, duties and fees.

Trade conducted between the free zones and other regions of Turkey is subject to the foreign trade regime. Upon request, goods originating from Turkey of less than 500 US dollars value may be exempted from export procedures. The foreign trade regime is not applicable for trade conducted between the free zones and other countries or free zones. In contrary to most free zones of the world, sales into the domestic market are allowed in Turkish free zones. Goods destined to the free zone that originate from Turkey and goods utilized during the investment and construction stages, as well as instruments, tools and equipment brought into the free zone for repair and maintenance purposes, are exempt from the payment specified for 'Free Zones Establishment and Development Fund'.

Any authority regarding prices, quality and standards granted to public institutions and agencies by laws or other legislation is not valid in the free zones. Red tape and bureaucracy have been minimized during application and operation phases by authorizing only one agency in charge of these procedures. Moreover, all provisions of Municipality Law No.1580 except paragraphs 5, 22, 25, 32 and 47 of Article 15; Passport Law No.5682; Law No.5683 for Foreigners Travelling and Residing in Turkey and Law No.2007 on Professions and Services Allocated for Turkish Citizens including its Annexes and Amendments; Foreign Investment and Encouragement Law No.6224; Law No.2677 on the Implementation of Duties and Services at the Civilian Airports, Ports and Border Gates; General Accounting Law No.1050; Supreme Court of Finance Law No.832; provisions of the State Bidding Law No.2886 and provisions of other laws contrary to this Law is not applicable in free zones. In addition to this, for a period of 10 years following the commencement of operations in the free zones, the strike, lockout and mediation provisions of law No.2822, dated May 5, 1985, is not applicable in the zones. However, any disputes airing within the context to collective bargaining during the period is resolved by the Supreme Arbitration Council.

Infrastructure of the Turkish Free Zones is competeble with international standards. The validity period of Operation License is maximum 10 years for tenant users, and 20 years for other users who wish to make their own offices in the Zone. If the requested Operation License period is in excess of 20 years the period can be prolonged to 99 years.

4.3.2.4. Organized Industrial Zone and Small Industrial Estate Incentives

Incentives provided by the Ministry of Industry and Trade for Organized Industrial Zones (OIZ) and Small Industrial Estates (SIE) are as following (Küçük Sanatlar ve Sanayi Bölgeleri ve Siteleri Genel Müdürlüğü, 1998); use of funds created for the establishment of OIZs and SIEs, tax exemptions, land provision and construction of infrastructure.

Fund for the Construction and Operation Expenses of OIZs and SIEs is used to provide entrepreneurs with low interest credits (Arrow 5 on Figure 6) (Table 28). In addition to provision of credits for the construction of infrastructure of OIZs, the Ministry of Industry and Trade also provides entrepreneurs with cheap industrial land (Table 28).

Table 28 - Credits given to entrepreneurs for the construction of infrastructure of Organized Industrial Zones and rules of provision of industrial land (valid beginning from January 1, 1998).

		Developed Regions	Normal Regions	First Priority Regions
Infrastructure Constructions	Minimum equity ratios (%)	10	5	1
	Interest on credits (%)	50	40	25
	Max. terms of the credits (years) Number of years without repayment Number of years with repayment	9 2 7	11 3 8	15 5 10
Provision of Land	Minimum equity ratios (%)	25	20	10
	Interest on debts (%)	50	40	25
	Max. terms of the debts (years)*	4	6	10

*Repayment of debts for provided land should be started and finished within the maximum terms of the credits provided for the construction of infrastructure.

Source: Küçük Sanatlar ve Sanayi Bölgeleri ve Siteleri Genel Müdürlüğü, 1998: 84.

Tax exemptions provided for OIZs and SIEs can be given as below (Table 29 and 30);

Table 29 - Tax exemptions available for firms operating in Organized Industrial Zones.

Tax Exemptions (March 1999)	First Priority Regions	Other Regions
Construction and Operation Permission Levies	100%	100%
Property Tax Exemption	Available for 5 years beginning from the completion of construction of buildings	
Environmental Purification Tax Exemption	Not available if OIZ is inside the municipal boundaries. But available if OIZ is inside the mücavir boundaries and collecting its garbage itself.	
Exemption from Corporate Income Taxes	Available only for the sale of land by Entrepreneurial Formation	
Exemption from Value Added Tax	Available only for the sale of land by Entrepreneurial Formation	

Source: General Directorate of Industrial Districts and Estates, Ministry of Industry and Trade.

Table 30 - Tax exemptions available for firms operating in Small Industrial Estates.

Tax Exemptions (March 1999)	First Priority Regions	Other Regions
Construction and Operation Permission Levies	100%	100%
Property Tax Exemption	Available for 5 years beginning from the completion of construction of buildings	
Environmental Purification Tax Exemption	50% except for the ones within the boundaries of Greater Municipalities	50% only for the ones within the boundaries of Municipalities having less than 5,000 population
Exemption from Corporate Income Taxes	Available only for the sale of land and workshops by Construction Cooperatives of Small Industrial Estates	
Exemption from Value Added Tax	Available only for the sale of land and workshops by Construction Cooperatives of Small Industrial Estates	

Source: General Directorate of Industrial Districts and Estates, Ministry of Industry and Trade.

In addition to these, the Ministry of Industry and Trade has two another fund in order to support the development of national industry (Organize Sanayi Bölgeleri ile İlgili Mevzuat, 1998: 28-37). One of these is Industrial Credit Fund which aims at development of industries producing goods not available enough for the whole country, development of industries producing export products and development of industries for import-substitution. This credit is given according to the following priority; Associations of Cooperatives, Joint Stock Companies established by at least 50 Turkish workers living in abroad, Joint Stock Companies with at least 100 associates and at least having 51% of share open to the public, other Joint Stock and Limited Liability Companies. The other fund is Entrepreneurship Support Fund which aims at development of cooperations open to the public. The priority used for the allocation of credit is the same with the former fund.

4.3.2.5. Incentives and Encouragement Schemes of SMIDO

In last two decades, small and medium sized firms producing high-tech products for small niche markets have increased in importance. Countries recognizing this fact have been supporting SMEs by providing them with consultancy services about financial, technological, educational, business administration and marketing issues (Göktepeli, 1995: 40-41). Within this framework, SMIDO, an agency of the Ministry of Industry and Trade, helps enterprises keep pace with the globalization process and technological developments. Since its inception in 1990, SMIDO has provided training and support to small enterprises to improve the quality of their products, help them upgrade their technology, and increase their chances of successful marketing and competition. SMIDO operates in close, direct contact with small entrepreneurs to assist them in diverse stages of business, from the process of establishment to production and marketing.

SMIDO's services, delivered through centers spread across the nation, include information, training, encouraging entrepreneurship, counseling, quality improvement, laboratory tests and analyses, modernization, blueprinting of industrial complexes, international promotion, R&D support, developing exports and marketing, access to financial resources, regional development, electronic trading and KOBİ-NET.

There are three kinds of service centers of SMIDO; Small *Enterprise Development Centers (SEDs); Technology Development Centers (TDCs) and Euro Info Correspondence Center (EICC)*[61] (Bureau de Rapprochment des Enterprrises (BRE), Business Cooperation Network (BC-NET) and European Info Center Network (EICC)). Framework of and incentives provided for technology development centers can be given as below:

Technology Development Centers have been established on university campuses for the purpose of helping people trained in scientific and technological fields to become entrepreneurs, establishing new technology-based enterprises, supporting similar steps taken by existing SMIs, commercialization of R&D efforts, development and diversification of regional economic activities and strengthening university-industry cooperation (Öz, 1995: 42-43 and Göktepeli, 1995: 43-44) (Arrow 10). They operate as 'Business Incubators' aiming to support technology-oriented development.

Using strong support mechanisms, SMIDO centers aim to create new technology-oriented enterprises and to establish suitable infrastructure for enabling these enterprises to develop their volumes and perspectives with the support of managerial, technical and administrative consultancy mechanisms. The basic philosophy is to open up to the market those firms which are mature enough to survive in market conditions and to admit new technology-based firms in their stead (Öz, 1995: 42-43 and Göktepeli, 1995: 43-44).

Services offered in TDCs are provision of places of work, consultancy services (technical, financial, administrative, management and marketing), access to BRE, BC-NET and EICC cooperation programs of the EU, on line access to university library, internet services, training services, office services, secretarial support, typewriter, fax, copier, phone, computer, documentation, exhibition and conference facilities, data show, conference and meeting rooms, fair services, support for participation in fairs at home and abroad, and other university facilities (free use of university laboratories and workshops).

If the firm pay the fee, the center makes it also possible for firms to employ academicians and successful students in order to develop new technologies and products. Normally when a prototype for which TDC meets most of the cost is produced, it remains in the center. But if the owner of the project wants to take the prototype with himself, he should pay the cost of project following the commercialization of prototype. No interest rate is charged for repayment which is realized in a long time period (Göktepeli, 1995: 44).

In addition to these, SMIDO also provides small and medium sized firms with additional R&D support within the framework of the first section of 'Decision About R&D Aids' (Decision No.2 for the year 1995) (Arrow 11). Projects eligible for SMIDO's R&D support are again selected by TSTRC (KOSGEB, 1999). The amount of financial support is determined according to the rules set down by Undersecretariat of Foreign Trade. Creation of a new product, quality/standard improvements and development of new production technologies can be listed as the R&D activities eligible for SMIDO support.

Furthermore, the findings emerged from the interviews held in METU-SMIDO-TDC show that incentives provided by different TDCs can be different from each other. For example, financial aid for prototype production is available in İTU-SMIDO-TDC but not available in METU-SMIDO-TDC. Instead in METU-SMIDO-TDC, firms are given low interest credits in order to purchase computers and related hardware.

Small and medium industries and new entrepreneurs aiming to develop new products, production methods or technologies can apply by completing application form which is available at the Technology Development Centers. The application form covers information on product or technology to be developed and the method to be employed, marketing ot , 42).

4.3.3. Some Concluding Remarks About Turkish Incentive System

Although R&D incentives designed by Undersecretariat of Foreign Trade (State Aids for Export Oriented Activities) are available in practice, generally R&D incentives designed by the Undersecretariat of National Treasury (State Aids for Investments) are not available in practice. Since the official communiqué have not been yet published in the Official Gazette, no credits are given to high-tech firms from IEF. In addition to this, it is also impossible to give R&D credits from the fund within the framework of previous decree and its related communiqué. In fact, the credits which were given within the framework of previous decree were only utilized by large holdings not by small and medium sized entrepreneurs. Thus, whether the decree is published or not is not important unless SMEs are also given some R&D credits. Another problem is the fact that, according to the experts working at the Undersecretariat of National Treasury, there is no application for the R&D credits provided by the current decree. This issue, unknowingness of small and medium sized high-tech firms about the investment incentives provided by the State, is also one of the findings emerged from the interviews held with the high-tech firms operating at METU-SMIDO-TDC, İTU-SMIDO-TDC, TSTRC-MRCT, AFZ-TDTC and İTI. Further elaboration of this issue is available in the next sections.

Definitionally there are investment incentive differences among different regions and among different sectors. But in practice regional and sectoral selectivity is very small and not in the direction of supporting R&D intensive SMEs and less developed regions. Lastly, parallel to the practical evidence on non-selectivity, it is generally large firms who benefit more from R&D investment incentives. Even the tragedy is that although R&D activities are characterized by large sums of investments, most of the firms have been benefiting from the R&D support of state within the framework of State Aids for Export Oriented Activities not within the framework of State Aids for Investments. This constitutes an opposition to GATT Uruguay Round. The Turkish incentive system is so chaotic that it is impossible to understand the rationale between the concepts and responsibilities of institutions. If all the R&D incentives were provided within the framework of State Aids for Investments, there would have been no opposition to GATT. Shortly, basic characteristics of Turkish incentive system can be given as following (Duran, 1998: 121-130); very centralized, very chaotic, not stable, definitionally based on regional and sectoral selectivity, not justly and equitably realized among small and large firms, lastly there is no feasibility and impact evaluation studies.

4.4. Legislation About High-Tech Intensive Regions in Turkey

In recent years, the rapid technological and economic developments all over the world have made it necessary for Turkey to review its science and economic policy in order to guarantee rapid access to the newest information about high-technology and consequently commercialization of available technological information. When mankind are approaching the 21^{st} century, the most important tool of providing people with wealth has become the employment of new production systems producing high value-added innovative products and services. Thus, by recognizing the importance of rapid commercialization of scientific knowledge, both developed and developing countries have adapted policies in order to fuse scientific knowledge and industrial production. Techno- and science parks aiming at the realization of collaboration between universities and industry have spread all around the world by creating competitive advantage to their respective regions as a result of the created high-tech innovations and new products.

Similarly, in Turkey the Ministry of Industry and Trade has prepared a proposal for the legislation of Technology Development Zones ('Draft Law for Technology Development Zones'). The justification for the Draft Law was the considerations made in the 7th National Plan on the issue of technological development. In 1995 the Draft Law was sent to all the related public and private organizations in order to ask their attitudes about the proposed legislation. Since the Turkish legislation requires a long time period, the Draft Law is not yet approved. Because of this, in order to facilitate the establishment of technoparks and Technology Development Zones, SMIDO has prepared a regulation which is easier to legalize as it requires the approval of only one minister, the Minister of Industry and Trade. Technoparks Regulation, which was prepared in this framework, is justified in accordance with the SMIDO Foundation Law No.3624. What follows is the analysis of the Draft Law and Technoparks Regulation.

4.4.1. Draft Law for Technology Development Zones

The objectives of the Draft Law relating to establishment of Technology Development Zones (TDZs) are as following (Sanayi Araştırma ve Geliştirme Genel Müdürlüğü, 1999a): to support information and technology intensive production and entrepreneurship; to increase

R&D activities and to contribute into economic development and regional development; to develop entrepreneurship capability and to improve entrepreneurship education which will mobilize the entrepreneurship spirit; to diversify and spread innovative production of goods and services and to increase the employment opportunities for well-educated high-quality engineers and scientists by creating information and technology intensive spaces where innovative high-tech industries are supported to incubate; and to integrate existing R&D power and technological infrastructure into economic life by establishing Technology Development Zones in accordance with the scientific and technological development policies of state.

Within the framework of the proposal designed for the legislation of technology oriented zones, the process of constitution of a Technology Development Zone, how it will be operated and supervised, its administrative structure together with the responsibilities of each organization in this constitution process are clearly defined and determined.

According to the Draft Law, the decision for the establishment of TDZs is taken by the Council of Ministers after the Ministry of Industry and Trade prepares the proposal. Determination of the location of the zone, preparation of the feasibility report, construction and operation of the zone, land use principles and determination of the activities eligible for TDZ together with the rules related to this is realized in accordance with a regulation which will be prepared by the Ministry of Industry and Trade.

The provision of the land, preparation of plans and projects together with construction of infra- and supra-structure is realized by the founder and operator firm. The preparation of implementation plans and construction of buildings are realized in accordance with the Planning Law No.3194. Required land can be expropriated in accordance with the Expropriation Law No.2942. Provided that universities approve the establishment of such zones in their campus areas, lands owned by the universities can be used for the establishment of TDZs. Lands owned by other public R&D institutes and organizations can be also used for the establishment of TDZs in accordance with the approval of the related organization or institute. Lands allocated as TDZs can not be used for other purposes.

The basic principle in order to establish a TDZ is that TDZ should be in close proximity with both R&D activities (universities and R&D institutes) and industries. The adequacy of universities in relation to the establishment of a TDZ is determined by Higher Education Institution. The implementation of the Law and related regulations will be realized by the General Directorate of Industrial Research and Development at the Ministry of Industry and

Trade.

According to the Draft Law, the management of Technology Development Zone (TDZ) is realized by an operator incorporated company constituted throughout the collaboration of Universities or High-Technology Institutes in close proximity with at least one of the following organizations; SMIDO, TSTRC, Chambers of Industry and/or Trade, Local Governments and Undersecretariat of Defense Industry. Moreover, according to the Draft Law, this incorporated company will be opened to the membership and participation of banks and financial foundations-organizations, national and inter-national industrial firms, R&D Foundations and Associations, Public Economic Enterprises and Associations of Exporters together with other related public organizations.

Furthermore, according to the Article 8 of the Draft Law, in accordance with the approval of the related organizations and institutions, public personnel can be employed in TDZs. In addition, employed university personnel will be exempted from the regulations related with rolling funds of universities. In this way, like experienced in developed countries, it is believed that the barriers over the transferring of academicians and scientists into the commercial world will be removed.

According to the Article 10 of the Draft Law, state aids and supports which will be provided for these zones will be determined by the Council of the Ministers according to the proposals of the Ministry of Industry and Trade. Moreover, financing of expropriation of the necessary land and construction of the infrastructure is within the responsibility area of the Ministry of Industry and Trade.

4.4.2. Technopark Bylaw

Objectives of Technopark Bylaw which aims at increasing the international competitiveness of national industry by supporting the collaboration between Universities-R&D Institutes and industries are as following (KOSGEB, 1998b): to produce technological information; to make innovations in products and production methods; to increase the standards and quality of products; to increase the productivity; to decrease the production costs; to commercialize the technological know-how; to support the technology intensive production and entrepreneurship; to realize the adaptation of small and medium sized firms to high-technologies; to create investment opportunities in accordance with the views and proposals of Higher Commission of Science and Technology; to create employment opportunities for researchers and creative entrepreneurs; to facilitate the transfer of technology; and to accelerate the introduction of foreign capital together with their R&D units into the country.

Technopark Bylaw covers the issues related to establishment, organization, operation, administration, supervision and coordination of technoparks. The justification for the Regulation is the Article 4, 12 and 17 of SMIDO Foundation Law (Sanayi Araştırma ve Geliştirme Genel Müdürlüğü, 1999b). According to the Article 5 of Technopark Bylaw, the services which will be provided within the Technoparks is defined as consultancy services (consultancy on: firm establishment, technology, production planning, financial responsibilities, accounting and finance, legal issues, marketing and supervision of firms) and technical services (secretarial and telecommunication services, software packages, library, laboratories and workshops together with exhibition rooms, access to patent catalogs, database systems and international databanks, documentation and reporting services together copying, computers and etc. services). In addition to these, social and health services will be also provided within the Technoparks.

According to the Regulation, in order to establish a technopark, Founder Committee applies to SMIDO. By filling an application form, Founder Committee provides SMIDO with a report which covers the following information about the technopark; general goals and policies of technopark, location of the technopark, potential number of researchers and scientists (potential scientific labor market), potential raw materials, existing situation of industry in close proximity, university-industry relations and marketing opportunities, the sectors in which technopark firms will realize activities, total area which will be covered by Technopark, determination of the necessary infrastructure, financial portrait, business administration, financial relations and sources, forecasted revenues and profits, and forecasted expenditures.

This report is evaluated by Technopark Evaluation Committee constituted by the representatives of Ministry of Industry and Trade, SMIDO, TSTRC, Higher Education Institution and Turkish Association of Chambers and Stock Exchanges. If the Committee approves the application, it is sent to General Directorate of Industrial Research and Development at the Ministry of Industry and Trade. The establishment process of technopark begins with the approval of the Minister of Industry and Trade.

So far as two technoparks have been approved by the Minister of Industry and Trade within this framework. These technoparks are METU-Tech and TSTRC-MRCT. They are the first legal technoparks of Turkey. Technoparks can be also established without the limitations of

4.5. How Much are Turkish High-Tech Incentive System and Technology Development Centers Successful? Case Studies on METU-SMIDO-TDC, İTU-SMIDO-TDC, TSTRC-MRCT-TDC, TDTC of AFZ and İTI

Turkish incentive system in accordance with the rules set down in GATT Uruguay Round provides only R&D activities and SMEs with direct financial aids. Other kinds of state supports are available for a wide range of sectors. Investment allowances, exemptions from custom duties, taxes and levies can be listed as tools of incentive system which are available nearly for all sectors aiming at mainly exporting what they produce. Principally there is a sectoral and spatial selectivity with respect to the provision of incentives and encouragement schemes but it is not very strict. Thus, according to the rules of the existing incentive system in practice one should observe high-tech firms benefiting more from the incentive system in which direct financial aids are only available definitionally for high-tech firms.

The case studies within this perspective aim at identifying to what degree state aids are available to high-tech firms and to what degree TDCs are functional with respect to services provided for small and medium sized high-tech firms (SMHTFs). Firms currently located at METU-SMIDO-TDC, İTU-SMIDO-TDC, TSTRC-MRCT-TDC, TDTC of AFZ and İTI, and firms definitionally graduated from these centers have been interviewed in order to highlight these questions. Interviews generally revolved around the questions aiming at highlightment of the above issues. However, once began some other interesting results have also become apparent from the interviews. What follows are the results obtained from these interviews.

4.5.1. Practical Evidence on Proper Use of Incentives Designed for High-Tech Firms

As seen from Table 31 and Table 32, incentives provided for SMEs and R&D activities within the framework of the decree published on 25th of March 1998 and its related communiqué published on 6th of May 1998, the decree numerated 99/12474 and dated 19.02.1999, and 'Communiqué About R&D Aids' (Communiqué No.10 for the year 1998) are not fully exploited by high-tech firms located at TDCs of SMIDO.

At METU, it is rather after the full commercialization of projects that firms begin to get information of and consequently benefit from incentive system designed for them. Although in general there is an unknowingness about the current R&D investment incentive system, nearly all of the successful firms mature enough to survive in market conditions are aware of the incentives provided for SMEs and R&D activities. One of the firms interviewed has benefited from the R&D support of Technology Observation and Evaluation Organization (TOEO) of TSTRC. Moreover, two of them want to apply for the R&D support of TOEO of TSTRC. At İTU and MRC, the use of R&D incentives provided by state is more widespread compared with METU. Many of the firms located at MRC have benefited from the R&D support of TSTRC and the others have application for the R&D support of TSTRC. This should be considered as a natural outcome of being located within MRC, which is a sub-institution of TSTRC. At İTU-SMIDO-TDC, three of the firms interviewed have used the R&D credits of TOEO and another two firms have applied for the R&D credits of TOEO.

However, there are also some complaints about the R&D support of TOEO. These complaints about TOEO credits are that TOEO credits decreases in value since it is registered as a revenue in accounting tables and the credits are given lately. This fact is confirmed by the firms located at METU, İTU and MRC. This leads to the fact that the actual R&D figures are lower than the ones written on the brochures. Owner of a firm at İTU points to this as following; 'They do not give support. In this incentive system, I do support them by paying taxes'.

What stems from interviews is that although R&D support provided by TOEO of TSTRC compared with the one provided by TDFT is relatively more suitable for SMHTFs, both R&D aids together with one provided by the Undersecretariat of National Treasury is generally more suitable for large firms which have separate R&D department having its own employment structure. Firms at TDCs are small firms having maximum 3-5 scientist and engineers working on R&D studies. However, large firms have more R&D personnel and they have benefit more from the R&D support of Undersecretariat of Foreign Trade and National Treasury in that the logic of the incentive system is designed in such a way that it is more beneficial for firms having separate R&D departments. According to the firms interviewed at METU, especially TDFT gives support only for large R&D investments. Among the firms interviewed at METU only two firms want to apply for the R&D support of TDFT. On the other hand, some of the firms interviewed at İTU argue that R&D aids provided by TDFT can be suitable for SMHTFs. Three of the firms interviewed at İTU want to apply for the R&D support of TDFT.

At İTU, there is another important source of R&D finance. İTU-SMIDO-TDC provides the firms located at the center with direct monetary aids for the procurement of production equipments and related services. This R&D support is given to firms in the form of low-interest credits. 30-35 firms have been given low-interest credits since the establishment of the center. The amounts of credits given to firms depend upon the requirements of the projects proposed by the firms. At most 70,000 US Dollars was given to only one firm up to now. The source of this credit is constituted through appropriation of a small part of tax payments done by industrialists as fund. Nearly all of the firms interviewed have benefited from this credit given by the center. What emerges from the interviews is that although at the early years of the center the amount of credits given by SMIDO was large enough to support important projects, now because of the financial problems there have occurred a decrease in the amount of credits given to high-tech firms. A similar credit is also given by METU-SMIDO-TDC, but it is quite limited in quantity compared with the one available at İTU-SMIDO-TDC.

Another interesting point that emerged from the interviews held at METU is the fact that there is no proper institutional framework in order to inform the firms about the current incentive system. The information about incentives and encouragement system is generally obtained throughout individual efforts. For example, it is generally Halk Bank's Young Entrepreneur Credit which is most used by the firms located at METU. According to the owner of a firm, why the firms obtain more credit from Halk Bank but not from other banks is because of the fact that Young Entrepreneur Credit of Halk Bank is obtained through out the individual efforts of METU-SMIDO-TDC's director whose older sister works for Halk Bank. The fact that the use of Young Entrepreneur Credit of Halk Bank is not very common among the firms interviewed at İTU and MRC also confirms this fact. At İTU, firms use bank credits with normal interest rates but not Young Entrepreneur Credit of Halk Bank. Owner of a firm interviewed at İTU claims that this is because of the fact that available low-interest credits are given to the firms having relatives working in or political influence on such institutions. In general, nobody have excellent information about the R&D incentives.

Many firms agree that incentives are very difficult to get. Two successful firms operating at METU and MRC point to the difficulty of getting a credit as following: "In order to get a credit you should prove that you do not need any credit." Nearly all of the firms complain about the fact that Turkish Incentive System is very bureaucratized and clumsy. Even one of the firms interviewed at METU argues that 'R&D studies are not supported but prevented'. He said that he was advised to establish a joint venture with Vakıf Risk but he added that he refused the joint venture as Vakıf Risk required lots of documents. According to two firms interviewed at METU and İTU, there are some other expectations which are more influential than the creative potential of engineers. For example, owner of a firm interviewed at METU argues that academic careers of applicants are very important for Vakıf Risk. This is also confirmed by the interviews held at TDTC of AFZ.

Another problem of Turkey is the lack of venture capital. In general, one of the complaints about the backwardness of Turkey in high-tech development is the fact that there is lack of venture capital (Babacan, 1996: 22). Babacan argues that in Turkey nobody wants to invest in high-tech sectors depending on R&D activities as the prevailing attitude towards the high-tech investments is that they involve high degree of risk. However, case studies at METU, MRC and AFZ show that there are some improvements in this challenge. For example, two of the firms interviewed at METU and AFZ are joint ventures with Vakıf Risk, which takes risky investments in high-tech sectors. Moreover, one another firm interviewed at METU is in the final stage of establishing a joint venture with both Vakıf Risk and one of the large firms in Çorum. Another firm interviewed at MRC has also an application to Vakıf Risk. In addition to these, there are other joint ventures with external firms. One of the firms at METU is established as a joint venture with the owner of a famous machine producer firm operating in Çorum OIZ. Another firm operating at TDTC of AFZ is a joint venture with a Sweden firm and produces steel arcs. At METU, there are also some other firms established in collaboration with other large firms not in the form of definitionally joint venture but in the form of implicit agreements. For example one of the firms will develop a software for the hardware developed by a large firm. In fact, they work as a subcontractor for a firm who have a legal contract with ASELSAN. The use of Vakıf Risk is not very common among the firms interviewed at İTU-SMIDO-TDC in contrast to METU-SMIDO-TDC. At İTU, existing and potential joint ventures between the firms interviewed at the center and the external large firms are not developed so much.

Some of the complaints are about the taxation system and accounting. Because of the lack of experience, most of the firms have been experiencing difficulties in accounting and business administration. In fact, problems associated with taxation system can be eliminated within the framework of incentives provided by the Undersecretariat of National Treasury. However, according to an expert working for the Undersecretariat of National Treasury, most of the incentives provided are for SMHTFs but it is not completely functional as investment allowances can not be fully utilized by those firms. He argues that except for the fund sourced credits provided for high-tech firms, other incentives are, in fact, more suitable for large firms as they have more input and output relations than SMHTFs. For example, according to him, investment allowances can be increased for SMHTFs as the amount of investment realized by small firms are already very small. But in practice just opposite is realized. For very large investments, investment allowance is 200% which is far higher than the one provided for normal R&D investments.

An interesting recommendation at this point has come from a firm and an expert working at the Undersecretariat of National Treasury. According to them, it is impossible to break the existing R&D Incentive System in such a way that it can become more suitable for small and medium sized firms as large Turkish firms prevent this attempt. Instead, they propose that investment allowances can be defined in two alternative ways; first as a certain amount of percentage of total R&D investment; second as a certain amount of money. For the large firms the first option is more profitable as they invest large sums of money for R&D. For the small and medium sized firms the second option is more suitable as their initial investment is not important compared with their operational costs. For example, for the second option 50 Billion TL can be defined for the investment allowance, in this way firms pay no tax till their total revenue reaches 50 Billion TL. In the case of first option, if the firm invests 15 Billion TL for its initial investment, it means that the firm will not pay any tax till its total revenue sums up to 15 Billion TL. As it is seen, without creating any disadvantageous situation for large firms it is possible to make small and medium sized firms benefiting more from the state incentives. If a large firm invest 200 Billion TL, it will be more profitable for him to choose the first option.

Tax exemptions and exemptions from custom duties are also useful in general for large investments and not adequately utilized by small high-tech firms. It is at this point, some of the interviewed firms have proposed that 'the time spent by sci-tech entrepreneurs for R&D studies should be decreased from taxes'. For small high-tech firms that constitute the backbone of real synergy, the initial investment which receives more incentive compared with operational costs is not so much important. Small high-tech firms require an incentive system that should be necessarily functional and available for the operational costs rather than initial investments. A more appropriate way of making small and medium sized high-tech firms benefiting more from the tax incentives can be the declaration of TDCs and Technoparks as Free Zones. This can be the most practical solution to the problems of small and medium sized high-tech firms within the existing legal framework. This idea is also emphasized by one of the firms interviewed at İTU-SMIDO-TDC.

4.5.2. Practical Evidence on Functionality of TDCs of SMIDO and MRC

In general there is a wide conformity among the firms about the usefulness of TDCs but this conformity is not without its critics. There are some complaints and also some key recommendations. There are also some structural and functional differences between TDCs. In general, TDCs of SMIDO have similar administration structures but their firm portfolio differs from each other. TDCs of MRCT, AFZ and İTI have their own independent administrative units. Since the number of firms located at TDTC of AFZ and İTI are currently very low, it is too early to judge the functionality of these centers. In fact, İTI has been in operation for a considerable time period and some judgment is possible to make about the fact that there is so little firm locating there in spite of its historical background. For TDTC of AFZ, it is really very early to judge about the future of the center. Thus, the initial findings about these centers are given in the previous sections in relation of overall Turkish high-tech industrial district constitution experience. Some references are also made in this section but they are limited in number. Naturally, what follows is the analysis of TDCs of SMIDO and MRC.

At METU and MRC, firms are generally established by new university graduates or researchers working at the university or research center. Although İTU-SMIDO-TDC is located within the campus area of İTU, it is rather external firms that use the facilities of the center. The formation of new firms established by new graduates is very low at İTU-SMIDO-TDC compared with the one at METU-SMIDO-TDC and TSTRC-MRCT-TDC. New graduates constitute a major part of the workforce at the center but they are generally employed by previously established firms for their R&D studies. Most of the firms operating at İTU-SMIDO-TDC are not embryonic spin-offs from university but they are previously established middle-sized high-tech firms. The fact that firms accepted to İTU-SMIDO-TDC on project basis creates an opportunity for some middle-sized external high-tech firms to establish permanent R&D offices at the center (a similar situation is also valid for METU-SMIDO-TDC where the main residents are young spin-offs not previously established firms). When the R&D project is finished, they develop and propose another R&D project. In this way, they continue to operate in the center and to benefit from the facilities of the university and SMIDO. Most of the modules at the center have been allocated as R&D offices of external firms. However, what emerges from the interviews held at İTU-SMIDO-TDC is the fact that for the engineers and scientist employed by external firms, the high-quality green environment of the university campus is more important than the facilities of university. They want to work in an environment which is more isolated from the external

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DOKÜMANTASYON MERKEZİ

world but at the same very close to vital services.

TDCs provide firms with more than one module according to the needs of the firms. Thus, the basic function of TDCs, provision of work place, is to some extent is in accordance with the services promised to be offered by SMIDO, MRCT and AFZ. No rent is paid but there is a payment for the services provided by the center. For TDCs of SMIDO, firms only pay for contribution fee which covers the expenditure done by the center for the services provided. In addition to contribution fee, firms pay only for telephone and fax bills. Firms pay no stoppage for the modules allocated to them for their activities. Although a small amount of many is paid for stoppage, what appears from the interviews is that these small amounts of payments totals to large sums. More important than this, according to the firms interviewed, is the saved time which can be wasted otherwise in order to pay the bills, stoppage and etc.

TDCs of SMIDO give support for participation in fairs at home and abroad. This facility covers 50% of the costs made by the firm in order to participate in fairs (50% of travel expenses of one person and 50% of the expenditures done for renting a stand for exhibiting the products produced by the firm). In addition to this, projects developed by the firms are sent to various fairs by SMIDO without any payment. This helps inform the industrial firms about the innovative projects taking place in TDCs. There are some interesting recommendations from the firms interviewed at METU and İTU on the issue of support for participation in fairs. Two firm propose that for the first fair support of the center for participation in fairs at home and abroad should be 100%, it should be 70% for the second fair and 50% for the third fair and so on. Shortly, they argue that a more systematic, fair and meaningful arrangement should be employed in supporting the firms for participation in fairs.

At TDCs of SMIDO, definitionally there are some other supports including training and education programs for business administration and financial issues. What stems from interviews held at METU is the fact that these services were available at the beginning but later because of the low level of participation the priority given to these services have decreased in importance. All of the firms confirm that directors of the centers do their best for them. However, they also confirm that bureaucratic barriers prevent them taking more responsibility. For example, TDCs could inform the firms about the current incentives available for R&D firms. Some of the firms point that there are enough personnel but there is no service for these kind of informing activities.

There are some basic differences between TDCs of SMIDO and TSTRC-MRCT-TDC. At MRCT most of the firms are established by the researchers formally working for the center. Researchers use 20% of their working hours for their firms and 80% of their working hours for their formal researches at the center. There are currently 6 firms established by researchers using this opportunity. TSTRC-MRCT administration is more successful compared with the other TDCs and technopark administrations in that they perceive the problems of high-tech firms as if they are their problems. They have recently begun to provide consultation services for R&D support applications to TSTRC, TDFT and other institutions. This organizational structure saves the valuable time of R&D firms and is what firms located TDCs of SMIDO dreams to realize. In addition to this, they want to create a venture fund in order to support high-tech firms. Within this framework, they began to investigate the structure of venture funds in Silicon Valley.

In contrast to other TDCs, at METU-SMIDO-TDC some firms have quite negative attitudes towards the functionality of the center. According to them, the center is just a show room. One firm owner points this as below;

> "If you ask me METU-SMIDO-TDC is just a show-room and nothing more than it. When somebody visits METU, he or she is shown the center and mentioned about the quality of research done here. That is all."

There are also conflicting arguments between the firms interviewed at METU about the real functionality of TDCs of SMIDO. On the one hand, some of them, especially state of art electronic device producers and those R&D firms, argue that TDCs should only accommodate R&D intensive firms not software developers or firms producing commercial products. On the other hand, some other firms, producing and developing products on the base of reverse engineering and software developers, argue that TDCs should be rather incubation areas where the projects should be commercialized easily. The latter group emphasizes that projects based on the local production of products produced in abroad should be eligible for the acceptance to TDCs. They argue that a step-by-step wise development is more appropriate for Turkish high-tech context. There is no such discussion at İTU-SMIDO-TDC, which is more integrated with local industry. However, implicitly the limitations to project selection imply a resistance to pure commercial projects.

The practical evidence shows a coexistence of these two arguments (TDCs function as centers of both incubation and R&D). In fact, definitionally only firms developing new products and dealing with R&D are eligible for the application to TDCs. However, most of the firms propose projects of state of art value, and after accepted to the center, parallel to the development of the project they proposed they also produce and develop more commercial projects because of the financial problems (a finding emerged from the interviews held at METU and İTU). One of the firms interviewed at METU points this fact as below;

> "The projects eligible for SMIDO-TDC should be commercialized easily. They should be more market oriented. Thus, they can be development of products already existing in international markets. We first proposed a project related with the development of a standard telephone device but it was rejected. Later we proposed a project which is more original than the first one. It is accepted but after locating at METU-SMIDO-TDC, we began to develop digital scoreboards because of the financial problems."

What emerges from the interviews is that İTU-SMIDO-TDC is more open to direct industrial projects and local industry than METU-SMIDO-TDC where there is a general complaint about the project selection criterion in that some of the entrepreneurs argue that projects accepted to METU-SMIDO-TDC should be more commercial oriented. At İTU-SMIDO-TDC most of the firms and engineers located at the center gain their livelihoods from the projects other than the ones they are supposed to develop. This is because of the financial necessities. Shortly, reverse engineering is more freely employed at İTU-SMIDO-TDC than at METU-SMIDO-TDC. Engineers working on the base of wages also develop some other projects besides the ones they are employed to realize.

İTU-SMIDO-TDC is more closely integrated with local production networks. At the center, one of the researchers is not a university graduate. He is a normal high-school graduate but by employing PLC technology he has developed a machine producing high-quality plastic bottles. He is just illustrative of learning by doing and the fact that TDC should be opened to all innovative entrepreneurs regardless of their academic career. One of the managers of the firm says that;

> "There are great innovation potentials embodied in the brains of non-university graduates working in small industrial estates and organized industrial zones as qualified workers. They should be identified and supported. They are afraid of state intervention and disturbance in their way of doing things. Experts of the center can be employed in order to inform them about the opportunities provided by TDCs."

Similar to İTU-SMIDO-TDC, TDTC of AFZ is also more open to direct industrial projects and local industry as it is located at the heart of an industrial zone. There are currently four firms supported by TDTC of AFZ. Apart from these four firms, there are some other high-tech firms located in AFZ not in TDTC. AFZ provides the firms located in AFZ with

AFZ has succeeded to create an atmosphere very similar to the campuses of universities.

Firms developing state of art products having both technological and commercial value are in minority in TDCs of SMIDO. However, in general, they are more successful than the others. Some of the firms are working like machines producing state-of-art products (a finding emerged from the interviews held at METU and İTU). Successful firms in developing state-of-art products generally commercialize their products and left TDCs. However, after leaving TDCs, their innovative capacity seems to be narrowed by the market pressures towards more standardized products. There are only a few firms who are successful in creation of state-of-art products but still operating in TDCs. According to the owners of these firms, this is a trade-off between innovative thinking and commercial thinking. At İTU, owner of a state-of-art bio-medical project says that he will sell his project to counter part firms in USA and Europe as he wants to continue to conduct further R&D studies in the fields of electronics.

There are some complaints about METU-SMIDO-TDC but they are rather for the provision of new services not for the ones provided by the center. Within this framework, METU-SMIDO-TDC is functional in accordance with the goals set by SMIDO in its effort to establish TDCs. Most of the complaints in fact is about the responsibilities or the things which are the responsibility area of METU not SMIDO. Common problems shared by all of the firms interviewed is rather related with METU. These problems can be listed as below;

- Entry to METU is very difficult; this creates difficulties for possible customers,
- Problems with telephone links; special telephone lines are impossible to obtain (due to the bureaucratic problems created by the University),
- They pay more fees for car stickers than others (30 Million TL for 1999),
- No monetary support is available from the center.

Even owner of a firm graduated from the center claims that the center will be rented to larger firms when the contract between SMIDO and METU is finished. His expressions show a reproach about METU.

> "I have benefited spiritually from the center but not the University. The moral support of the center is perfect but METU gives no moral support to young entrepreneurs. For my project, I needed to use the facilities provided by the laboratories and workshops of Department of Mechanical Engineering. I had experienced great difficulties in obtaining the required support. Teachers thinks that nobody demand their help unless

a profitable project is to be realized. Thus, they think that if somebody needs their help, this can be because of the fact that he or she has no other solution."

In contrast to METU-SMIDO-TDC, firms at İTU-SMIDO-TDC and MRCT-TDC benefit more from the facilities of İTU and MRC. And they have fewer complaints about the university and the research center compared with METU. Laboratories of university and research center are widely used by the firms located at these TDCs for certain chemical and biological analysis. It is only at METU, there is no further consideration for the firms located in TDC in that no additional module is under construction.

In most of TDCs, some institutions play crucial roles in the formation of high-tech base. At METU-SMIDO-TDC, it is only the university that creates spin-offs. But at İTU-SMIDO-TDC, İTU-ETA Foundation's Application Oriented Integrated Circuits Design Center besides İTU constitutes another potential source of spin-off. What emerges from the interviews held at the center is that since its foundation in 1991 the center have created some spin-offs but they have not chosen to locate at TDC. Instead, they have gone to Europe and USA. There are 3 researchers who chose to go to Silicon Valley for further career. In addition, some of them chose to go Belgium. Shortly, nobody chose to improve his or her career in Turkey after leaving the center. This may be because of the fact that Integrated Circuits (IC) Design is very expensive and local market is not large enough to establish new firms in this sector. What emerges from the interviews is the fact that there is no demand for integrated circuits design from small and medium sized firms as it costs about at least 40,000 US Dollars. Thus, IC design and production is only feasible for large sums of production. In Turkey, there are three centers where IC design is realized (İTU-ETA, TSTRC-MRC and Turkish Electronics Industry and Trade Inc. (TEITI)). And only in two of these centers, it is possible to realize IC production (TSTRC-MRC and TEITI). However, for final production İTU-ETA sends its designs to Europe.

The importance of military procurement of high-tech products is perceivable at TDCs of SMIDO. Two firms currently located at METU and İTU sell their products to ASELSAN. Two other firms graduated from METU and İTU have close contacts with ASELSAN. But there are some deviations from the world experience. In Turkey, high-tech firms develop solutions to the problems experienced with the existing technologies employed by National Defense. Thus, the dependence on foreign technology continues and high-tech firms are unable to accommodate sustainable solutions. What emerges from interviews is that there is potential for further development but it requires establishment of local knowledge infrastructure conducive to technological innovations and creation of trust. Interestingly, one firm interviewed at İTU has explicitly pointed to the importance of local tacit knowledge as the source of competitive power of local industry. He argues that in order to be competitive tacit codes of information should be established among local firms.

One another expectation (although implicit in form) from the establishment of TDCs is the creation of synergy among different firms operating in the centers. This synergy is realized to some extent but it is not at level of creating strong joint ventures. It is rather in the form of informing each other about the technological innovations, helping each other about the technological issues and problems, and informing each other about business administration and accounting problems (taxation system etc.). At METU, there is an active technological information exchange among a limited number of firms which are especially established by electronic engineers graduated from METU. In general, there is a hostility towards joint venture between high-tech firms themselves. Most of the firms are co-established more than one university graduate but after the establishment of the firms, they begin to specialize in different technologies. In general there is no common project developed as a result of the cooperation between different firms. According to owner of a firm interviewed at METU, the low level of networking between firms is due to the lack of trust among firms. He has mentioned about the theft of a project and added that this has created a hostility among the firms against each other about creation of possible joint ventures. Among the firms interviewed, only one of them points to this and considers this as a handicap in front of them. His wordings are thought-provoking;

> "We could not succeed to develop a proper synergy among us. Many friends think that partnerships are difficult. But I do not think so. It is possible. We have experienced a partnership with another firm in the center. It was a great pleasure. Both firm have benefited from this partnership."

He notes that to constitute shared challenges in order to solve common problems other than technological problems is also difficult. He said that he arranged a meeting on taxation. He added that nearly all firms had participated in the first meeting but later the participation level decreased as weeks went on.

The expectations on behalf of constitution of collaboration between R&D and local industry are realized to some extend but it has a dual structure. In principle, there is no mass production activity at TDCs. On the one hand, some of the firms at TDCs function as R&D firms developing technology for external firms and they do not commercialize their product themselves (production of only prototypes). On the other hand, some of the firms commercialize what they develop as prototype. In this two different form of relations there are also different tendencies towards the collaboration with traditional local industry. In the former group, firms interviewed at METU complain about the fact that traditional local industry is unable to respond their demand in product quality and standard. One of the sci-tech entrepreneur, an electronic engineer interviewed at METU, complaints that they experience great difficulties in developing new products for mechatronics field as mechanical parts are not designed and produced at the level of quality they want. Just because of this, he said, he decided not to develop any project in mechatronics. Firms located at İTU-SMIDO-TDC experience less difficulty in finding high-quality subcontractors compared with other TDCs. Production networks prevailing in İTU-SMIDO-TDC are based on turnkey manufacturing relations. In the latter group, firms are generally happy with the quality and services of local producers. However, there are some complaints not because of the quality of the products but because of the low number of alternatives. At METU, owner of a successful firm graduated from the center complaints about the dependence on only one subcontractor because of the fact that there is no other choice. This subcontractor firm is able to convert AutoCAD drawings directly into material outputs by using a very sophisticated technology. They say that they will establish a production facility similar to the one provided by that firm as soon as possible. They want to internalize the production of mechanical parts of their products. They say that no matter how much it will cost for them. They also recognize the fact that normal subcontractors are incapable in mechanical product designs and productions. Shortly, all of the mass production activities are realized outside TDCs by quality subcontractors but for some products the final assembly is realized at TDCs because of the necessity. Some of the small innovative firms point to difficulty of breaking the chain of multinational corporations and creating market opportunities for their innovative products.

One another function of TDCs of SMIDO was to provide industrialists with academicians and research assistants (successful young graduates) in order to solve their technological problems. However, the director of METU-SMIDO-TDC said that this model did not work properly. This model is a little bit conflicting with the one that aims at the creation of new sci-tech entrepreneurs. It is may be because of this fact, in practice it could not be successful. This function, in fact, is already realized to some extent by the firms producing state of art technologies requiring R&D.

Another expectation from TDCs is increased number of patent applications and granted patents. Although patent applications shows to some extent the quality of R&D done in a country, it is not the whole story which takes place in TDC. What stems from interviews is that patent applications are not very high as the protection of patent rights is very expensive.

[illegible] of [illegible] on [illegible] of [illegible] of [illegible], [illegible] a [illegible] is considered to create high rates of profits, no patent application is made for it. Low number of patent applications is partly justified by the firms interviewed in terms of above argument. In addition to this, some of the firms producing products which can be easily copied by reverse engineering thinks that the protection of patent law is not adequate for them as once others obtain the information about the technique they employ there is no use of patent protection. Patent protection is not reliable as with minor modifications it is possible to copy all the products they develop and produce. Another reality about the law number of patent applications is the fact that some of the projects are difficult to be patented. For example garbage collection and disposal plants designed for producing energy and organic fertilizers. Therefore, number of patent applications and granted patents can not alone show the degree of technological development and synergy among firms.

However, the fact that more than 50% of the firms interviewed at METU want to apply for a patent or have patents shows that METU-SMIDO-TDC is successful in producing high-commercial-value products and projects. Number of patent application at İTU-SMIDO-TDC and MRC is very low compared with METU-SMIDO-TDC, there is no granted patent given to the firms operating at these center. At MRC, some of the firms want to apply for a patent. In TSTRC-MRCT, currently most of the patent applications are generally realized by the researchers working at MRC not by the firms located in the TDC. This is partly because of the fact that at MRC there exists an advisory bureau that facilitates patent and utility model applications of researchers working for the center.

Lastly, it is interesting to note the future location considerations of firms. The basic philosophy of TDCs is to support firms till they are mature enough to survive in market conditions and to admit new technology-based firms in their stead. Within this framework, firms are supposed to leave the center after a period of incubation. What stems from the interviews held at METU is the fact that firms are tend to locate in Ankara and especially near to METU (100. Yıl, Çetin Emeç Boulevard and Çankaya) when they leave the center. Firms graduated from the center are already located in areas easily accessible to METU (Çetin Emeç Boulevard and Çankaya). There are still some linkages between the firms graduated from the center and the ones still operating in the center. These linkages are both on technical and social issues. Some other firms want to establish their future production facilities in OSTİM-OIZ located in Ankara. Interestingly two firms plan to establish their production facilities partly in Çorum-OIZ as one of them is established as a joint venture firm with the owner of a firm located in Çorum, and the owner of the other firm was born in Çorum and want to establish a joint venture with another firm in Çorum. The fact that METU-SMIDO-TDC will open a branch TDC in Çorum is also important for the latter firm to plan to locate his production facilities in Çorum.

At İTU-SMIDO-TDC, firms leaving the center choose to locate at a wide range of places available in Istanbul. In contrast to METU-SMIDO-TDC, there is no tendency to be near to the TDC after leaving the center. One of the firms will locate its production facilities in Balıkesir OIZ because of the fact that industrial land in İstanbul is very expensive. On the other hand, one of the graduated firms has already a branch office in AFZ. Another firm will locate its R&D and production facilities in Aachen Technology Region in Germany as they are offered that they will be provided with free industrial land besides the plants of large electronics firms of Multinationals. Thus, there are no agglomeration tendencies among the firms interviewed at İTU after leaving the center. But there are quite diverse tendencies. However, what emerges from the interviews is that expectations of the firms are on the behalf of provision of cheaper industrial land in close proximity with TDC. The diverse tendencies in location selection are because of the lack of cheap alternative agglomeration spaces.

At MRCT-TDC, firms leaving the technopark choose to go to İstanbul. Only one firm graduated from the TDC chose to establish its production facilities in Adapazarı OIZ. However, in contrast to METU-Tech, most of the firms operating currently at MRCT-TDC are going to locate their production facilities at the technopark which is under construction. What emerges from interviews is that METU-Tech is going to be a location for R&D centers of large firms not a special space of territorially embedded agglomerations of small and medium sized firms. MRCT seems to be more successful in attracting high-profile small-scale companies to its hinterland compared with METU-Tech.

From the interviews held at METU, METU-Tech appears to be a location that is very expensive for small firms to afford to hire an office (even a very small office). It is somehow unrealistic to wait that firms graduated from or forced to leave the center will locate in METU-Tech unless cheaper offices (maybe in the form of modules) are provided for small-scale high-tech firms. A similar phenomenon was also experienced in Shangdi Information Industry Base (SIIB). Because of property-driven development and the ideal location of SIIB for high-tech business, office rents there are high. This results in a spatial agglomeration of two kinds of firms: the successful local giants and the branches of large multinationals

(Wang and Wang, 1998: 693). One of the purposes for multinationals to come to SIIB is to set up their R&D centers for tailoring their products designed elsewhere to meet the needs of China's market. Absorption of the top R&D people by the branches of international giants is therefore inevitable in both METU-Tech and SIIB.

Table 31 - Summary of some key points for the firms interviewed at METU-SMIDO-TDC.

No	Firm	Research areas	Used incentives and credits	Patent Applications
1	TEKNO-PLAZMA Inc. Com. (1996)	Development of thin ceramic coverages for industrial use	Joint venture with Vakıf Risk (VR) R&D support of TOEO (TDFT support is more suitable for holdigns rather than SMEs)	Turkish patent law is not reliable. Protection of patent rights is very expensive
2	ATİKUS Ltd. (1994, 1996)	Various state of art electronic products and their softwares (only prototype pr.)	Young Entrepreneur Credit of Halk Bank (HB). Application for R&D support of TOEO (TDFT support is more suitable for holdigns rather than SMEs)	Protection of patent rights is very expensive. Only valid for big investments (it is generally customer firms that apply for the patent)
3	MEDİSPO Ltd. (1997)	Bio-medical products and their softwares; invaziv blood pressure trandusers and cardiographic devices (state of art products in bio-medical industry)	Young Entrepreneur Credit of HB 'Turkish incentive system is not dynamic' (TDFT support is more suitable for holdigns rather than SMEs)	They have a granted patent secured in 37 countries. But in general they also think that protection of patent rights is very expensive.
4	EGIS Ltd. (1996)	Image Processing for industrial supervision and customer specific projects	Young Entrepreneur Credit of HB 'Turkish incentive system is not dynamic'	Protection of patent rights is very expensive
5	FİLKON Ltd. (1998)	Softwares for Military Systems (Embedded and Microwave System)	Provision of computers by METU-SMIDO-TDC (with equity ratio of 15% and without repayment for 2 years)	They develop software products which are difficult to be patented
6	DİZGE Ltd.* (1996)	Development of hardware and software for chromatography	Young Entrepreneur Credit of HB Application for R&D support of TOEO	Protection of patent rights is very expensive but they want to apply for a patent
7	EKON Ltd.* (1998)	RF SCADA, industrial dust collection systems and electronic measurement devices	Young Entrepreneur Credit of HB Application for the R&D support of TOEO and TDFT. Application for JV with Vakıf Risk	As he wants to realise mass production of his projects, he thinks that to apply for a patent is necessary for him.
8	ATD Inc. Com. (1996)	Producing energy and fertilizer from organic garbages	Joint Venture with owners of Alapala Inc. Com. located in Çorum	They establish in fact garbage disposal plants
9	ON Ltd.** (1992, 1993, 1995-1998)	Digital Score Boards and telecommunication	TDFT support is more suitable for holdigns rather than SMEs	In 1998 he applied for a patent for his new innovation, traffic de-counter.
10	GATE Ltd.** (1989, 1992) GATE Inc. Com. (1995)	Repair of all kinds of electronic cards, production of electronic card test devices and establishment of complete electronic laboratories	Subsidised credit facility of HB, Credit from Investment Encouragement Fund, Investment incentives; exemption from customs duties and fund levies, investment allowance, exemption from taxes, duties and fees, Application for the R&D support of TDFT	Protection of patent rights is very expensive but they want to apply for a patent when they begin mass production of defect finder test devices.
11	ORTANA Ltd. ** (1992) (1996)	Digital Displaying Systems (score boards etc.) and production of electronic card test devices	Young Entrepreneur Credit of HB (1995), Subsidised credit facility of HB (1998) 23 Billion TL. There is too much bureaucracy for the given incentives. It is costly both in time and money.	They had a granted patent but they sold it. They have also applied for a utulity model. They have several trade marks.

* firms established by university graduates other than METU

** graduated firms from METU-SMIDO-TDC

Table 31 - Continued from the previous page.

No	Customers	Future Location	Future Activity	Networking
1	ASELSAN, Roketsan, Türk Traktör Fabrikası	OSTİM is more attractive. METU-Tech is very expensive	To realise R&D activities of big firms and to continue to develop new materials.	Theft of a project little networking
2	They develop hybrid technologies so there is no predefined customers (Hospitals, Emniyet Müd.)	100. Yıl or a location near EBİ. METU-Tech is very expensive. 'Koç and Sabancı can locate' OSTİM is not adequate	To continue to develop R&D intensive state of art electronic products. They do not enter into the field of mechatronics.	Networking is both on technical and social issues.
3	Hospital, doctors, universities, laboratories. They export their new patented product	Şaşmaz (where bio-medical producers are concantrated), OSTİM or Batıkent, and New York (for the new product)	To continue to develop R&D intensive bio-medical state of art electronic products.	Networking is both on tecnical and social issues.
4	Possible customers are firms employing mass production lines but currently TSTRC. Customer specific projects	100. Yıl (There is already a place currently used as depot). METU-Tech is very expensive	To develop cheap modular image processing devices by analysing existing technologies.	Networking is rather on social issues. Helping to repair computers
5	They work as a subcontractor for a firm which have a legal contract with ASELSAN	Silicon Valley	Support to consultancy and training systems for defence industry and electronic war systems	
6	Hospital, doctors, universities, laboratories.	Çetin Emeç Boulevard METU-Tech is very expensive	To continue to develop bio-medical electronics products. (They want to produce a polygraph)	Networking is both on tecnical and social issues.
7	Only for one of the projects a prototype production is realised but possible customers are cement producers, millers and other firms.	OSTİM or Çorum OIZ	To develop electronic measurement devices and other projects.	Networking is both on tecnical and social issues.
8	OIZs, SIEs and Municipalities, individual firms.	Ankara (50-100 m² of land is enough for them to demonstrate their projects (products))	To continue to develop useful garbage disposal technologies	Networking is both on tecnical and social issues.
9	Municipalities, advertisers, stadiums etc.	Çankaya (existing location) OSTİM (future consideration) METU-Tech is very expensive	To continue to develop new techniques in digital scoreboards.	Networking is both on tecnical and social issues.
10	The Ministry of Natinal Defence (%50-60 of all production and services), maintanence and repair of electronic equipments of big holdings (Holdings of Koç, Sabancı, and Toprak)	Çetin Emeç Boulevard Bilkent (They have a building under construction in Bilkent. They want to transfer production facilities to there).	To continure to develop computerised defect finder devices for electronic cards and devices. They will develop electronic detectors for the Ministry of Justice.	Networking might be on tecnical issues when they were located at the center.
11	ASELSAN, SIEMENS, Stadiums, Municipalities, Air Ports and other customers needing special displays	Tunus Caddesi. They do not want to change their current location.	To continue to develop state of art digital displays and computerised defect finder devices for industrial applications other projects.	Networking is both on tecnical and social issues.

* firms established by university graduates other than METU

** graduated firms from METU-SMIDO-TDC

Table 32 - Summary of some key points for the firms interviewed at İTU-SMIDO-TDC.

No	Firm	Research areas	Used incentives and credits	Patent Applications
1	İTÜ-ETA Vakfı (1991)	Design of application specific integrated circuits for industry needs	No information is available	Patent application is done by customer firms. Protection of patent rights is very expensive.
2	MESTAŞ Inc. (1994, 1996)	Production of machines controlled by a micro-processor and producing plastic bottles, and various customer specific buil. automation pro.	SMIDO credit (20,000$), R&D support of TOEO, 'Turkish incentive system is not dynamic' (They could not apply for R&D support of TDFT because of the formalities). They do not know VR.	Protection of patent rights is very expensive. Only valid for big investments.
3	EKA Inc. (1977, 1992-1999)	Production of 800 KVA UPSs and other power electrics and electronics products.	SMIDO credit, R&D support of TOEO, R&D support of TDFT (about 500,000$)	Patent protection is not reliable (with minor modifications it is possible to copy all the products they develop and produce).
4	TELECON Inc. (1992, 1995-1996)	Production of GPS systems in Turkey (previous project is intelligent security systems). Also some customer specific projects realised by eng.	SMIDO credit (one computer and one PLC unit), 'Turkish incentive system is very chaotic' (They could not apply for R&D support of TDFT because of the unknowingness).	They want to apply for a patent if the project is finished.
5	DALYA Inc. (1998)	Limiting intake of various foods. (They use 2,500 ingredients for this purpose).	Support of SMIDO (computer and internet). They want to apply for R&D support of TOEO.	They want to apply for a patent.
6	UCA Inc. (1991, 1994)	Various state of art Bio-medical products (electrotherapy and electronic bloodless surgical operations).	Support of SMIDO for the procurement of production equipments (6,000$). R&D support of TOEO (approximately 50% of the R&D investments) and R&D support of TDFT (150,000$).	He will apply for a patent for the prototype which provides doctors with bloodless surgical operations.
7	ALTINAY Ltd. ** (1991-1993)	Various industrial and commerical robots except for automotive industry. (They think that Vakıf Risk is not suitable for Turkey because they say that it is political).	Support of SMIDO for the production of the their first robot. They have applied for R&D support of TDFT (500,000$) and TOEO. Both applications have been accepted by TDFT and TOEO. They have used bank credits with normal interest rates but not Young Entrepreneur Credit of Halk B.	Protection of patent rights is very expensive. Only valid for big investments. 'Turkish incentive system is not dynamic and it is very chaotic because of bureaucracy'.
8	ELO Ltd. ** (1980, 1991-1996)	Production and programming of PLCs for industrial and commerical use.	Only support of SMIDO. 'Turkish incentive system is not dynamic and it is very chaotic because of bureaucracy'.	Patent protection is very expensive and not reliable (with minor modifications it is possible to copy all the products they develop and produce).
9	TESAN Ltd. ** (1982, 1995-1996)	Computerised design and production of textile products.	They have a branch in AFZ. Thus, they utilize all the incentives provided within free zones (tax exemption, duty free import of goods etc.). They say that no benefit have emerged for them from locating in TDC.	They want to apply for a patent if the project is commericalised successfully.

Table 32 - Continued from the previous page.

No	Customers	Future Location	Future Activity	Networking
1	ASELSAN, NETAŞ, ALCATEL	No opinion (may be the locations around the Maslak Campus of İTÜ)	To continue to design ASICs. To realise in-house production of ASICs.	There is no any other firm realising ASIC design in İstanbul.
2	Potential customers for the researh project are firms producing chemical and biological products for mass consumption.	Balıkesir OIZ and Bayrampaşa in İstanbul, (Agean Free Zone is very expensive. That is whay they do not want to locate there.)	To commercialise the researh project and to continue to develop PLC applications for industry. (Learning by doing and using)	Networking is both on tech. and social issues but not with the firms located at TDC.
3	ASELSAN, India, Taiwan, Israel, Mexico and Turkey	The modul at TDC is just for R&D. The center of the firm is somewhere else near to the Maslak campus of İTU.	To continue to develop products in the field of power electrics and electronics.	Little networking with the firms located at TDC (on technical issues)
4	For the intelligent security systems; government instiutions and large firms. The potential customers for GPS systems are municipalities and ASELSAN.	The modul at TDC is just for R&D. The center of the firm is somewhere else in İstanbul (Anatolian side).	To continue to develop GPS systems if the current projects become successful.	Little networking with the firms located at TDC (on technical issues) but there is considerable networking with other firms.
5	Güllüoğlu Baklavacılık and other various firms producing high-calorie foods.	The modul at TDC is just for R&D. The center of the firm is somewhere else in İstanbul (Anatolian side).	To continue to limite the intake of various foods used by people.	Formal relations with university chemical laboratories.
6	Doctors, hospitals, rheunatic people etc. (he dreams another project which will lead to technological leadership of Turkey in the field of alternative energy sources).	The modul at TDC is just for R&D. The center (office) of the firm is somewhere else in İstanbul (Anatolian side; Bostancı).	To continue to develop and produce bio-medical products. To produce the first fusion energy as an alternative to traditional nuclear energy powerhouses.	Little networking with the firms located at TDC (on technical issues)
7	Arçelik, Şişecam, Pakmaya, Eczacıbaşı and EAE.	The modul at TDC was just for R&D. Germany (Aachen Technology Region; they find Hakan Altınay and offer him to locate his firm in Aachen). The center of the firm has been in İstanbul since 1991 (Anatolian side; Kızıltoprak).	To continue to develop industrial and commercial robots. Their last project is case palleting robot.	Little networking with the firms located at TDC (on technical issues).
8	Ereğli Demir-Çelik, Şişecam, Çanakkale Seramik; main customers are small scale producers.	They do not want to change their current location at PERPA where a special space is constituted for electronics and electric firms.	To continue to develop and produce PLCs and to establish a project factory focusing on PLC applications by employing 8 engineers.	Little networking with the firms located at TDC (on technical issues).
9	Ready-to-wear clothing producers.	They have a branch plant in Agean Free Zone.	To finish the project developed in İTU-SMIDO-TDC.	No networking with the firms located at TDC

** graduated firms from İTU-SMIDO-TDC

CHAPTER 5

EVALUATION OF TURKISH HIGH-TECH INDUSTRIAL DISTRICT CONSTITUTION EXPERIENCE AND SOME POLICY IMPLICATIONS

5.1. Evaluation of Turkish High-Tech Industrial District Constitution Experience

With the practical evidence available in Turkey, it is impossible to test all of the statements set in the introduction. This is because of the fact that Turkish high-tech industrial district constitution experience is a very new phenomenon. However, there is some significant experience in order to evaluate current situation and to derive some initial recommendations. Some argue that success of the policies can be evaluated in accordance with the goals set in them. This is a fair way to judge the current experience but it is not enough to reach the best practice. Whether policies are formulated in accordance with the relevant world practice is of much importance. Thus, the real success of the Turkish experience should be judged in accordance with the evaluation of world experience of and theoretical discussions revolving around high-tech growth and development.

World practice shows that classical perception of the causes of the high-tech existence and development as a linear path of development prevents real synergy and miss the central importance of cooperation between industrial production and R&D. However, Turkish high-tech industrial development is basically characterized by linear model of innovation. According to linear model of innovation, innovation can be realized throughout a linear path that introduces a several-stage innovation process beginning with an academic or research idea which is gradually transformed into finished new goods. This process is characterized by spatial proximity of firms to universities and R&D institutions rather than to industrial zones.

In any regulation mechanism (ranging from spontaneous growths to planned developments), linear model of innovation constitutes the initial stage of development of high-tech industrial development. The regulatory practice of Turkey also coincides with this fact. But this does not prevent the implication of relevant world practice. The implication of world experience of high-tech region constitution is that parallel to the development of high-tech based industries on the base of linear model of innovation, development of innovation capacity should be considered in relation to capability of local industries. Linear model of innovation supports the constitution of spin-offs from universities and R&D institutions but there may be more innovation capacity in the brains of non-university graduates working as qualified workers in industrial estates and organized industrial zones. Technology policy should not be based on a trade-off between supporting new university graduates and supporting identification of capabilities of local industry. The crucial point is whether countries are able to drain into their scientific and technical potential regardless of any definitional limitation. The limitations on technological development sometime stems from definitional frameworks employed in policies and consequently in legislations.

Implications of the linear model of innovation are highly observable in most of Turkish experiences of high-tech industrial district constitution. Except for the TDC of AFZ, all of the technoparks and TDCs in operation epitomize and reinforce a strategy developed on the base of linear model of innovation. Thus, current practice in Turkey limits researchers to visualize further issues having crucial importance in high-tech development. Although TDC of AFZ is based on a concept showing many similarities with modern models of innovation, there are no significant findings from the interviews as it is in its embryonic stage. Identification of potential of Turkey for the employment of models of modern innovation theory remains as a further and more detailed research topic and is currently beyond the scope of this thesis.

To a certain extent, it is possible to say that linear model of innovation has been successfully employed in Turkish technoparks and TDCs. Although the number of firms is very small, there are initial signals of the further development if necessary preventions are taken. Incentive system is supportive of high-tech firms in their effort of creating new products and technologies in the fields of high technology. However, it is not without its critics. With respect to the number of firms accommodated, there are three important centers of high-tech firm formation among the others. They are METU-SMIDO-TDC, İTU-SMIDO-TDC and TSTRC-MRCT-TDC. Each of these centers accommodates at least 15-20 high-tech firms. Most of the practical findings are supportive of the initial success of these TDCs.

Implicit in its form, linear model of innovation requires also a strong government involvement in the creation of technoparks and TDCs. Inevitably in Turkey central government agencies, like SMIDO and TSTRC, have played crucial roles in constitution of high-tech centers. Turkish experience of high-tech creation exhibits an overlapping of regulation mechanisms of developmental and corporatist state models. It is developmental in character in that it intervenes in the spontaneously generated evolution of the spatial organization in order to control and direct it by the implantation of strategically located growth poles and growth centers (TDCs and Technoparks). A corporatist state structure is also perceivable in that regional and urban policy in Turkey is also influenced by private sector led developments, local governments and other national policies such as military spending and education policy. The findings from the interviews shows that government procurement of high-technology products together with defense spending provides the main motivation for some of the firms in order to conduct further R&D studies. The technical specifications of the military products ensure the sustained combination of scientific knowledge and industrial production. Thus, Turkish experience confirms the fact that central government, directly or indirectly, plays important roles in constituting high-tech regions. The involvement of national technology policy and thus government in creating high-tech region is inevitable. Ranging from absolutely planned developments to spontaneous occurrences, there are different mixes of government involvement.

The local self-help institutions are also very important in information dissemination and collaborative action. It is sometimes local governments and self-help organizations that give birth to high-tech industrial region. There are two such kinds of TDCs; İTI and ATRP. They are just illustrative of the fact that such kinds of initiatives are possible in Turkey. However, the role of local governments in the constitution of these two centers is limited only to be a founder member. They provided neither any industrial land nor any technical infrastructure. In general, local governments in Turkey are unaware of the potential of high-tech centers as tools of local economic development. Although investing in high-tech is very attractive for local governments due to the direct and indirect repercussions of high-tech centers, Turkish local governments have very little effort to support local high-tech firms. Furthermore, as Turkish central government is not willing to recognize the fact that small and medium businesses are more tied to local government than to the central state, local government led high-tech projects become more and more difficult to be realized. To begin local government led high-tech projects requires that central government should overcome its deep-seated distrust of the local governments and recognize the fact that SMEs are more tied to local governments. Once this is succeeded, it seems to be easier to persuade local governments to invest in high-tech development.

Evaluation of successful world experience shows that high-tech development is not independent of local socio-economic and socio-spatial considerations. It is highly territorially embedded but territorial embeddedness of high-tech industrial production does not prevent its development somewhere else. In this early stage, Turkish TDCs and Technoparks have minimal territorial embeddedness. It is to early to judge whether Turkish technology districts are successful in establishing untraded interdependencies as territorial embeddedness requires strong trust-relations which can be realized only in the long-run. Currently, firms in TDCs and Technoparks seem to be independent of territorial conditions defined by the socio-spatial system of their respective regions. There are some handicaps that prevent sustained agglomeration of high-tech firms. Firstly, without agglomerating and establishing long-term face-to-face contacts, it is impossible for firms to realize the magic formula of synergy, trust and reciprocity. But there is nearly no tendency among the firms to agglomerate together as there is little effort and incentive in this direction. Firms are given modules at TDCs for 3-5 years of incubation phase and after incubation they are expect to leave modules. There are some efforts to establish technopark in vicinity with TDCs but they are so expensive that most of the firms graduated from TDCs are unable to locate their production facilities in Technoparks established nearby the TDCs. MRCT seems to be going to constitute an exception but it is to early to judge as the technopark is still under construction.

Regulatory tools which are used by the state in intervening the system should be designed in such a way that agglomeration of high-tech firms should be realized. Existing incentive system which support high-tech firms has some spatial considerations and implications but it is not enough to give birth to strong agglomerations. Surely, specific legislation favoring high-tech firm formation and agglomeration should be realized but sometimes legislation activities take such a long time period that it is more practical to employ the existing legal framework. For example, TSTRC-MRCT is going to have a free zone status in order to make it possible for high-tech firms located in the center to benefit from the incentives of free zones. In Turkey, establishment of technoparks is realized in accordance with the Technopark Bylaw but technoparks are characterized by spatial proximity to universities rather than to industries. In addition to this, a draft law related to technology development zones has been prepared but not enacted yet. It is only after the establishment of technology development zones, high-tech firms can have the opportunity of agglomerating on a scale that is more conducive to real synergies among quite wide range of sectors and firms.

Technology development zones should be based on high-tech industrial production not pure R&D activities already realized in technoparks. Technology development zones can serve as mass production sites but still remain as innovative regions for the projects of successful spin-offs.

Shortly, in Turkey, there are some growth poles for the genesis of high-tech firms but there is lack of special high-tech agglomeration spaces. Thus, the problems associated with high-tech industrial development in Turkey are mainly related with evolution and transformation of high-tech regions. The lack of venture capital together with lack of potential agglomeration locations lead to the dispersion of firms over a wide range of second alternative locations and synergistic atmosphere of innovation can not be transformed into viable high-tech regions where trust-based networks among reciprocal firms give birth to the local tacit knowledge creation and virtuous cycle of innovation.

Turkish high-tech industrial development experience is far from the stage of decentralization of routinized production function to periphery. But this stage of high-tech development requires employment of models of modern innovation theory. Within the framework of linear model of innovation it is assumed that existing high-tech centers are already high-tech product design centers as no mass production activities are allowed in technoparks and TDCs. Of course the collaboration and cooperation between university and industry is a necessary one but it is not the only way of innovating. What is needed in Turkey is the development of a system within which more tacit code of knowledge is produced and used.

On the issue of creation of tacit knowledge, the function of patent rights constitutes another point of departure for further discussion. Evaluation of world experience shows that generation of granted patents can not be alone indicative to judge whether a high-tech industrial district is successful or not. All of the researchers on this issue argue that dissemination of knowledge in high-tech regions is realized throughout the movement of labor from one firm to another and patents can not prevent circulation of valuable knowledge. Although some argue that this is a favorable characteristic of high-tech regions, some others argue that this is not a favorable arrangement to the economic development of the region. Turkish experience is again far away from these discussions as high-labor mobility requires high degree of agglomeration. Although patent applications show to some extent the quality of R&D done in a country, it is not the whole story that takes place in TDC. What stems from interviews is that patent applications are not very high as the protection of patent rights is very expensive. There are some patent applications and granted patents but they are characterized as being products of expectations on behalf of commercialization of products.

The fact that high-tech firms are naturally and predominantly small and medium ones is confirmed by the case studies conducted at TDCs. Spin-off nature of high-tech firm constitution necessitates this fact. Trust and reciprocity (untraded interdependencies) among networking firms require further time and spatial agglomeration of firms to be apparent. Firms interviewed at TDCs are aware of these concepts and have explicit intentions for the realization of such kind of relations. This can be considered as the sign of potential developments. Interfirm alliances which is the source of technological upgrading and an important indicator of powerful high-tech base is observable to a certain extent in the form of joint ventures but not so much available in practice. The fact that the distinction between the high-tech regions and other regions is based on quality subcontracting relations rather than quantity subcontracting is observable in TDCs.

In general, networking relations at TDCs are based on quality subcontracting. Although this kind of networking is characterized as being a favorable networking arrangement, in Turkish case it stems from the necessity as there is so little firm formation and alternative subcontractors. This is due to the fact that the low level of knowledge accumulation limits the possibilities open to state-of-art product producers. In addition, lack of high-tech agglomerations prevents the rapid new product introductions and continual technological exchange. Alternatives open to Turkish high-tech firms are very small in number. Shortly, the product-life-cycle of products are so short that firms naturally choose to establish quality subcontracting relations which is characterized by reliance on a small number of subcontractor firms specialized on certain technological applications and productions.

Networks are based on the fact that the cost and risk of developing new products are spread across networks of autonomous but interdependent firms. In Turkish high-tech context, networks are established as it saves valuable time of researchers. By subcontracting all the routinized production processes, they focus on developing new products. Due to the nature of the products, networks are established on the base of quality expectations (turnkey manufacturing) not on the base of pure price reductions. But the decentralization of production and reliance on networks is not limited to small or new firms seeking to avoid fixed investments. Even large producers have restructured internally to gain flexibility and technical advantage. Turkish context is more familiar with this latter phenomenon.

World experience shows that a wide range of information and financial incentives are provided to high-tech firms by employing certain regulatory tools. Cheap credits, special tax treatments, duty free imports of factory equipments and raw materials, bank loans with low interest rates, education and training programs to upgrade the technological knowledge of workers, provision of land and government procurement of technological products can be listed among the regulatory tools used in the formation of high-tech firms

The utilization of incentive system designed by central government is not realized equally among high-tech firms as Turkish R&D incentive system intrinsically favors large scale investments rather than operational costs of small and medium sized firms. Definitionally there are investment incentive differences among different regions and among different sectors. But in practice regional and sectoral selectivity is very small and not in the direction of supporting R&D intensive SMEs and less developed regions. In Turkey, the lack of venture capital and funds increase the importance of R&D incentives provided by the state. Investment Banking System has entered into the scene of high-tech development recently. Vakıf Risk and Young Entrepreneur Credit of Halk Bank constitute the first examples of this development which aims at financing potential high-tech projects of small and medium sized firms. Although R&D incentives designed by Undersecretariat of Foreign Trade (State Aids for Export Oriented Activities) are available in practice, generally R&D incentives designed by the Undersecretariat of National Treasury (State Aids for Investments) are not available in practice. Thus, some of the incentives provided are not available in practice. This is partly because of the fact that most of the small and medium sized high-tech firms are unaware of the investment incentives provided by the State.

Even the tragedy is that although R&D activities is characterized by large sums of investments, most of the firms have been benefiting from the R&D support of state within the framework of State Aids for Export Oriented Activities not within the framework of State Aids for Investments (a natural outcome of the non-availability of R&D investment incentives in practice). This constitutes an opposition to GATT Uruguay Round. The Turkish incentive system is so chaotic that it is impossible to understand the rationale between the concepts and responsibilities of institutions. If all the R&D incentives were provided within the framework of State Aids for Investments, there would have been no opposition to GATT. Shortly, Turkish incentive system is very centralized, very chaotic, not stable, definitionally based on regional and sectoral selectivity, not justly and equitably realized among small and large firms, and lastly has no feasibility and impact evaluation studies.

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The main argument behind the interactive innovation models of modern innovation theory is the fact that universities clearly plays a significant role in the formation of some of the high-tech complexes, but that does not mean that high technology complexes can only germinate in proximity to universities. It is sometimes traditional production agglomerations, which are more conducive to innovations than universities and R&D institutions. Another finding which have emerged from the literature is the fact that government R&D Institutes are more conducive to creation of high-tech region than university R&D in that they are directly involved in high-tech production as partners and consumers. Practical evidence on Turkish TDCs and technoparks shows initial signals of this fact. TSTRC-MRCT-TDC, a government R&D Institute, has more favorable arrangements for spin-off creation than other TDCs. At MRCT most of the firms were established by the researchers formally working for the center. Researchers use 20% of their working hours for their firms and 80% of their working hours for their formal researches at the center. In addition to this, within the framework of 'royalty agreements', firms located at TSTRC-MRCT utilize the R&D personnel and laboratories of MRC. After the commercialization of the project, according to ratio specified in the agreement, a small part of the profit is paid to TSTRC. This payment continues for a period of time specified in the agreement.

Basic characteristics of high-tech labor market are observable in Turkish context but some characteristics need further time to be apparent. Naturally scientific workforce constitutes the majority of the labor market but a structured labor market is not perceptible as Turkish high-tech industrial district experience is in its embryonic stage. Most of the workforce is constituted by engineers and scientist. Technicians and qualified workforce constitute a small part of the workforce and in contrast to current world practice they are paid well as they are being highly qualified during the production of prototypes. Generally, scientific workforce work on the shop-floor and there is no evidence on the direction of middle-class disdain of physical production. Scientists and technologists do not see involvement in production as a low status and they do not prefer to work in areas characterized by being distant from direct production. Turkish high-tech industrial district experience is not at a stage that determines the social stratification and structuring of the urban landscape. As so few technicians and qualified workers are employed in TDCs, the concept of labor union is unfamiliar with the current experience. The fact that informal interaction, informal dress, a non-hierarchical structure are all features of high-tech labor market is observable in Turkish experience as scientific workers are seen explicitly as 'human capital'. Generally there is no formal time recording of attendance of the R&D staff. R&D staff work on projects basis and there is a low level of supervision on them but workers in general overcompensate for this flexibility. Part-time employment of university students and research assistants is very common in TDCs but there is no evidence on the fact that in high-tech regions the rise of vicious cycle of labor shortages gives rise to consequently vicious cycle of wage increases as there is currently no labor shortage in TDCs and Technoparks.

The fact that in developed nations state procurements of military products constitute the main driving force behind many innovations is not valid for Turkey. As given before in Chapter 2, Table 7 shows that in most of developed countries defense related R&D expenditures have an important share in total national R&D expenditures. In Turkey there is some improvements in this direction but it is not at the level of complex network relations conducive to breakthrough innovations. Within this decade some local high-tech firms developing defense related technologies have received procurement contracts of the Undersecretariat of Defense Industry but most of these contracts are related to the development of ancillary technologies. Thus, military financing in Turkey does not permit companies a degree of trial-and-error exploration of new technologies that private sources of finance would never have allowed.

To some extent training and education programs are available for high-tech firms and entrepreneurs located at TDCs. The main responsibility on the issue of success of education and training programs seems to be belonged to the firms themselves. What emerges from the interviews is the fact that TDCs are ready to arrange training and education programs but the problem is that there is a low level of participation from the firms and entrepreneurs to the designed programs. For the design of training and education programs, there exist a demand side policy. In other words, directors of TDCs are preparing these programs in accordance with the wills of firms. However, this demand side policy is not available for other requests from the firms located at TDCs. For example, although TDCs have adequate personnel for handling the problems and routine works associated with applications for R&D credits and incentives, except for MRCT-TDC there is no effort from the TDCs to employ the existing personnel for these routine works which consume the valuable time of researchers.

Lastly, the rhetoric lives up to its image in that the fact that image of high-tech industrial sites attracts researchers and scientist to their respective region is partly also observable in Turkish context. Favorable environmental conditions of TDCs and Technoparks other than material terms attract high-tech firms to these centers of innovation. Large green areas, silent environment and scenic architecture of universities attract researchers and scientists to TDCs.

5.2. Some Final Implications and Policy Prescriptions for Turkish High-Tech Industrial District Constitution Efforts

Unfortunately, Turkey has captured the capacity and reality of high-tech world very lately. Other countries, for example Korea, Taiwan, Singapore and Malaysia have entered into the scene of high-tech world beginning from 1970s. In spite of this late introduction to the high-tech world, case studies show that Turkish high-tech industrial district constitution experience is at the stage of maturing into viable sustainable high-tech agglomerations. There are considerable spin-offs from universities and R&D institutes but there is no agglomeration tendency among the high-tech firms incubated in TDCs as there is no alternative agglomeration space. The linear path of growth should be transformed into synergic coexistencies conducive to innovations of all kind. This transformation can be realized by creating special spaces of high-tech agglomerations where mass production of innovative products is possible.

On the issue of creation of territorially embedded high-tech agglomerations, responsibilities of state intervention and firms should be well identified. The historical experience of world shows that declaring a region as an island of innovation is not adequate to create synergies among knowledge workers. Innovation atmosphere requires more than definitional limitations and incentives provided by the state. The term synergy is the solution to these problems. Modern innovation theory places the central emphasis on trust and synergy as they constitute the material evidence of a real innovation atmosphere. Synergy is a word that is much used in recent literature on innovation, but that is difficult to define. It can best be regarded as the generation of new and valuable information through human interaction.

Thus, the problem is the creation of human interaction. State can declare special spaces of high-tech agglomeration having great incentives and priorities but that special space of high-tech agglomerations can not be transformed into territorially embedded high-tech industrial districts because of the lack of human interaction which leads to the formation of synergic atmosphere of innovation and production. Thus, responsibilities of firms on the behalf of creation of viable high-tech regions are of greater importance compared with the ones of state.

Responsibilities of firms are recognition of existing socio-spatial structure of their respective region as the most valuable factor leading to synergies and creation of shared challenges for the future survival of this socio-spatial structure. The formation of common representation, shared challenges and cooperation is necessary to develop viable high-tech environment. But what emerges from the interviews held at TDCs is that Turkish experience is far from recognizing its existence as a social outcome of the spatial coexistence of small number of local conditions created by universities, government agencies and incentive system. In general, there is a hostility towards shared challenges. In order to overcome this problem, firms should learn to trust each other through synergic phenomena. Synergy is very often seen in terms of networks connecting individuals in many different organizations - public and semipublic and private, non-profit and for-profit, large-scale and small-scale within a system that encourages the free flow of information and, through this, the generation of innovation. Such a place is the archetype of the innovative milieu, which can be defined as a place where synergy operates effectively to generate constant innovation, on the basis of a social organization specific to the production complex located in that place.

It is important to make the distinction between information networks and 'knowledge networks'. Information networks can provide information on possible market areas and can be used in order to market new products of high-tech firms. In addition to this, some basic technical knowledge can be also diffused through information networks but it is limited in its codified form. Creation of local tacit knowledge is, however, realized through knowledge networks. Through knowledge networks meaningless information turn into meaningful information. This meaningful information can be partly codified but it can not be transferable to other locations due to the intrinsic abilities of knowledge networks available only in its native location. Creation of information networks can be within the responsibility of the state but certainly the creation of knowledge networks are in the responsibility of firms having shared challenges.

There is also a danger to waste the scarce financial resources available for technological development. Innovation Centers of Germany (Tamásy, 1999) should be illustrative of the fact that establishing so many technology centers can decrease the quality of these centers because oversupply of innovation centers transform them into standard industrial parks. TDCs of SMIDO have also increased so much in number that it is currently impossible for SMIDO to give low interest credits to firms operating in TDCs. The budget of SMIDO hardly meets the wage bills of its personnel. Do we really need so much TDCs? I do not think so. What emerges from the interviews held at TDCs is the fact that high-tech firms need special spaces of agglomerations not new TDCs. New TDCs in peripheral regions, OIZs and IEs can be beneficial to the development of indigenous innovation capacity of their respective region but establishment of new TDCs in close proximity to each other and only in campuses of universities is not meaningful and lead to the deterioration of the concept of

TDC. Firstly, the acceptance criteria to these centers decreases as so few firms apply to TDCs. Secondly, to establish new TDCs can not be feasible as there exist so few application to TDCs.

TDCs can also specialize in different technologies but there is no tendency for the constitution of specialized TDCs. For example, bio-medical firms can concentrate together. According to the findings emerged from the interviews, there is some potential for the agglomeration of firms producing bio-medical products for there is a considerable number of firms specialized on bio-medical technology. This field of high-tech industrial production may help integrate Turkish high-tech production into the world web of innovation and open new opportunities. In addition, at least networking of firms having production in the same field can be supported. Furthermore, TDCs have to operate more actively and with **a demand orientation** from firms, in order to satisfy the real needs of young firms. What emerges from the interviews is the fact that except for the MRCT-TDC, other TDCs are poorly oriented to meet actual business demand of high-tech firms. **A demand side policy should be developed**. New strategic elements like the combination of innovation centers with high-value business space and the establishment or use of networks, which have proven to be successful, should be firmly integrated into the concept. Cost aspects (personnel costs and operating costs) should be more highly considered, in an effort to avoid an uncritical distribution of public funding by government agencies.

Incentive system should be also designed in such a way that feasible agglomeration of high-tech firms should be guaranteed. Although definitionally Turkish incentive system is based on sectoral and regional selectivity, in practice sectoral and regional selectivity is not operational and there is waste of scarce resources over a wide range of unproductive sectors and small agglomerations. Unless an incentive system is based on a regional and sectoral selectivity, there is no use of it in creating agglomeration spaces. BEZ is also just illustrative of this fact. New high-tech firms located in BEZ are provided with tax exemptions in order to promote self-development. However, the power of this policy has subsided because of the establishment of another fifty-one-new-tech-zones at the state level that apply the same tax policy (Wang and Wang, 1998: 687). A very effective political determination is necessary to define special agglomeration spaces as growth nodes of high-tech development and to define potential sectors specific to Turkish context (such as bio-medical industry).

Moreover within the framework of investment banking system venture funding should be supported by the central state policies. Lack of venture capital prevents the creation of create a venture capitalism atmosphere, all the necessary measures should be taken. Although in Turkey there are some signs of initial formation of venture capital funds, it is in its embryonic stage. In addition to this, there is need to develop pools of venture capitalists. One of the basic reasons of the backwardness of Turkey in R&D activities is the fact public and private mentality in Turkey do not give any premium to R&D activities. Entrepreneurs are very abstaining in investing high-tech sector because of the fact that it involves a high dose of risk. Most of the R&D expenditures in Turkey are realized by large firms and universities are more willing to participate in high-tech industrial district constitution efforts than private sector.

In fact most of these problems stems from the fact that in Turkey science and technology policy could not be transformed into a national policy with the participation of all of the parties involved in high-tech development. TSTRC can take some responsibility in this issue but there is little sing in this direction. Beginning from 1970s, most of the Asian Tigers have invested heavily in potential high-tech sectors (micro-electronics, opto-electronics, photo-voltaics, bio-medicals and mechatronics). Unfortunately, in Turkey there is no central institution to coordinate high-tech development and until the 1990s Turkish incentive system was not supportive of potential high-tech sectors. Today there is some sectoral selectivity but it is not at the level of identification of narrow potential sectors. Niche markets should be identified and technologies related to these markets should be supported. For example as stated before according to the findings emerged from the interviews held at TDCs bio-medical industry in Turkey has a great development potential.

In addition to this, developing countries having relatively cheap brainpower have also great potentials for the development of software industry. However, this potential of software industry is not fully conceived by Turkish politicians and bureaucrats. There are some efforts in order to make it possible for small software developer firms to agglomerate together and create synergies conducive to innovation. SHFZP is just illustrative of these initial efforts but it is not yet approved by the Undersecretariat of Foreign Trade. These formative efforts should be rapidly realized. Universities are creating pools of scientists and engineers but Turkish industry can not successfully drain into this pool. It is also very difficult to say that vocational high-schools are very functional in Turkey. Potential vocational high-school graduates having a good background on high-tech sectors are not supported for further education at universities but they are prevented. Vocational-technical school graduates should be motivated to continue to specialize in high-tech sectors.

National Plans have been giving special importance on the issue of creation of technology zones but there is no detailed consideration for the creation of these zones. When developed countries are disemploying the linear model of innovation and are creating new concepts of innovation such as learning region, the insistence of Turkish politicians and SPO on the employment of tools of linear model of innovation is unintelligible. To increase the number of researchers and to increase the share of R&D spendings in GDP can not be solutions to the high-tech problems of Turkey. There are more in the minds of qualified workers employed in industrial estates and OIZs. Unfortunately, the social aspects of high-tech development are neglected in National Plans. Without knowing the existing potential of Turkey, it is impossible to define right policies aiming at high-tech industrial district constitution. Social studies should be directed to the problem of lack of coordination between universities and industries. Field studies covering OIZs and IEs should be conducted and potential entrepreneurs and firms should be identified. They should be informed about the fact that they can get state aids for their R&D activities and projects. For example, SMIDO can organize all these activities and constitute provincial databases about the industrial structure of each province. The problem with linear model of innovation is in its funding philosophy. In Turkish context, innovation potential is too narrowly defined as a result of the dominance of linear model of innovation. Could greater effects be realized with respect to the creation of jobs, if the same TDCs were placed in OIZs and IEs?

Shortly, TDCs are generally extensions of national system of innovation but we should convert them into territorially defined innovation systems. On the one hand, national systems of innovation employ the tools of linear model of innovation. On the other hand, territorially embedded innovation systems use interactive innovation models of modern innovation theory which is based on interactive learning, synergic coexistence, trust-based relations and institutional thickness. The formation of territorially embedded regional systems of innovation as an alternative to regionalised national systems of innovation represented by most of TDCs and other top-down technology policies based on the linear model of innovation should be realized.

It seems that regions dominated by territorial agglomerated SMEs can develop a large innovative capacity as a basis for endogenous regional development and a region with mainly regionally oriented independent SMEs is better served with a regionally embedded innovation system than a region with large enterprises and their suppliers or a region with mainly branch plants. As Hassink notes (1997: 13), for this purpose there is always a need for 'enterprise support systems, such as **technology development centers,** which can help keep networks of firms innovative' but there is also need for special spatial agglomerations of high-tech firms. The expectations from territorial planning and policy making are the realization of coordinated development. First, its responsibilities for education and outreach, among other areas, require the public sector to understand the external environment in order to better shape and promote policies that lead to programs designed to encourage continuous learning. Second, not all elements of the economic sphere can search, acquire, internalize, and act upon the high level of information needed to be competitive in the world today. By being informed about industries, the public sector can create institutional contexts to help acquire, digest and distribute information and also use it for its own planning purposes to revitalize and animate institutional functions. The regional policy and planning function is key to greater and more equitable regional economic development.

More experimentation is needed to determine what firms need and how to better enhance their internal learning capabilities in the future. In addition to this, patent rights should be judged from the point of view of their overall effect upon the general industrial development as there are currently some pessimism about this issue. Moreover, there are also some problems associated with the functionality of vocational schools. In spite of large sums of investment in these schools there is no sign of significant improvements in the creation of job opportunities for the graduates of these schools. Furthermore, appropriateness of new concepts relating to the agglomerations of innovative firms and creation of tacit knowledge (such as learning region) to the Turkish context should be evaluated by examining the potentials of namely 'Anatolian Tigers'. All these constitute areas of further research and experimentation.

NOTES

[1] For further discussion of this issue see Harvey (1976). Harvey gives the introduction of Fordism as a classic example of the attempt by capital to shape the person in the living place to fit the requirements of the work place. According to him, 'when capital intervenes in struggle over the built environment it usually does so through the agency of state power' and he identifies interventions under four broad headings: private property and homeownership for the working class, the cost of living and the value of labor power, managed collective consumption of workers and the imposition of work discipline (Harvey, 1976: 272). As far as, collective consumption is concerned, Harvey points out that 'capitalist systems have moved more and more towards the collectivization of consumption because of the need to manage consumption in the interests of accumulation'. "By collectivization, consumer choice is translated from the uncontrolled anarchy of individual action to the seemingly more controllable field of state enterprise." (Harvey, 1976: 278)

[2] Lean production brings us a flexibility within firm organization and production but industrial district models brings us a flexibility between small firms.

[3] Long wave theory began with the work of Nikolai Kondratieff who suggested that long-period cycles of an average length of about 50 years could be identified throughout the history of capitalism (Kondratieff, 1935: 105). Schumpeter refined this theory, arguing that two shorter cycles were laid over the long Kondratieff waves (Schumpeter, 1939: 169-174). Schumpeter in his historical outline used a three-cycle schema: the forty-month or Kitchin cycle, the ten-year or Juglar cycle, and the 60-year or Kondratieff cycle (Schumpeter, 1939: 169). He defined these business cycles as the process of 'creative destruction'. By combining the Schumpeterian theory of business cycles and perspective of regulation school, Freeman and Perez (1988: 38) argue that certain types of technical change have such widespread consequences for all sectors of the economy that their diffusion is accompanied by a major structural crises of adjustment, in which social and institutional changes are necessary to bring about better 'match' between the new technology and the system of social management of the economy - or 'regime of regulation'. Once, however, such a good match is achieved a relatively stable pattern of long-term investment behavior can emerge for two or three decades (Freeman and Perez, 1988: 38).

[4] Many observers believe that agglomeration economies are becoming less important as rapid changes in telecommunications and computer technology are reducing the need for face-to-face contacts and eroding the benefits gained from minimizing communications costs (Hudson, 1999: 64 and Richardson, 1984: 25). However, Scott and Storper argues that there is no reason to expect the end of agglomerative forces, even with continued rapid improvements in transport and communications technologies, because the revolution in electronic means of communication has not only failed to undermine processes of large-scale urbanization, as was so frequently predicted in the 1970s, but it has actually led in many cases to considerable spatial reconcentration (Scott and Storper, 1987: 223; and Amirahmadi and Wallace, 1995: 1754-8). Morgan and Storper also argue that untraded interdependencies (such as tacit knowledge) is collective in nature and, as it is wedded to its human and social context, it is more territorially-specific than is generally thought (Storper, 1995 and Morgan, 1995: 495). In principle, on-line computer services can make technical information available to users of this information irrespective of location, but close physical proximity is important to the creative use of technical information (Simmie, 1998: 1265; Premus, 1988: 445 and Amirahmadi and Wallace, 1995: 1755). Communication can only to a certain extent be a substitute for transportation of people, depending upon the nature of the information exchanged and the functional purpose of exchanging it (Amirahmadi and Wallace, 1995: 1754 and Hermansen, 1975: 305). IT is the basic variable which provides the regions with superiority but this does not prevent the using of the superiorities based on the traditional factors (Eraydın, 1995: 15).

[5] There are many reasons for vertical disintegration. First, labor processes resist integration into unified machine systems. Second, if output markets are unpredictable or unstable, producers may disintegrate in order to avoid the transmission of uncertainty through the vertical structure of the firm. Third, final output producers may require inputs which can be manufactured more efficiently by firms which devote specialized managerial attention or firm-specific knowledge to this task. Finally, these same inputs may be produced in plants having minimal optimal scales of operation which can only be

attained if they serve a multiplicity of downstream firms (Scott and Storper, 1987: 221). Vertical disintegration is a common feature of modern industrial production, not a deviation from mass production (Piore and Sabel, 1984). Whatever the reasons for vertical disintegration of labor processes, it tends to create increasing returns via external economies, i.e. steadily falling production costs resulting from the specialization of firms (Scott and Storper, 1987: 221).

[6] Verdoorn effect as hypothesized by Thirwall by utilizing the ideas of Myrdal assumes 'that once a region obtains a growth advantage, it will tend to sustain it at the 'expense' of other regions because faster growth leads to faster productivity growth which keeps the region competitive in the exports of goods which gave the region its growth advantage in the first place' (Thirwall, 1989: 141). *In terms of Verdoorn effects, high technology growth centers are outcomes of the same generalized processes that were responsible for the creation of earlier growth centers based on the textile, car, and machinery industries* (Scott and Storper, 1987: 221).

[7] Industrial district concept refers to the spatial clustering of several, predominantly small firms from the same or closely interconnected branches of industry and a specific local labor market. And indeed, within Marshall's concept of agglomeration economies are found the germs (embryonic form) of much later key neoclassical economic insights concerning the significance of transaction costs and the resulting merits of markets versus hierarchies (Marshall, 1964: 222-227). But Marshall is going beyond even that: escaping from the constraints of neoclassical equilibrium analysis, he is anticipating the dynamics of Schumpeter's concept of innovation. And even beyond Schumpeter: for Marshall correctly saw, what others were to see much later, that the process of innovation consists not in a single heroic act by a Schumpeterian 'new man' but in a continuous chain or cascade of innovation set in motion by that first act (Marshall, 1964: 225).

[8] 'Technology District' refers to agglomerations in which technologically dynamic industries are located (Storper, 1992: 434). Storper emphasizes the behavioral basis for inter-institutional relations which lead to learning, arguing that rules, institutions and practices of key collective agents enable local technological learning. According to him, agglomeration seems to be tied to three principal dimensions of technological change: technological (lock-in vs. flexibility); economic (cost-minimization, knowledge spillovers and externalities); and behavioral (qualities of transactions and learning). Drawing on export-oriented production networks in France, Italy and the USA, Storper shows that localized rules, institutions and practices are key both to their geographical concentration and their technological performance. He notes that patterns of geographical concentration and specific forms of innovation are linked to the conventions which define economic identity and participation at the regional level (Storper, 1992: 433).

[9] The work of the regulation school offers also a viable framework for investigation into the social construction of the industrial district (Tickell and Peck, 1992; Scott and Storper, 1987: 216; Digiovanna, 1996: 375 and Cooke, 1983:158). Regulation theory is a form of analysis which examines crises and change in capitalist societies (Boyer, 1988; Tickell and Peck, 1992; Scott and Storper, 1987: 216; Digiovanna, 1996: 375; Jessop, 1995; Hay, 1995 and Cooke, 1983:158). As a body of theory, it was originally developed as an attempt to explain the crisis which began in the 1970s in which the industrialized countries were experiencing declining rates of productivity and a number of economic shocks. Regulation theory reject the neo-classical view that crises was an aberration under capitalism. Instead, combining aspects of *Marxist and Schumpeterian analysis*, it concluded that crises occurred constantly under capitalism as a normal outcome of capital accumulation. Further, it is the crises themselves, and their subsequent resolution, which provide for dynamic change and accumulation under capitalism. Thus was created a new language which included such terms as *regime of accumulation, mode of social regulation and institutional forms* (Boyer, 1988; Tickell and Peck, 1992; Scott and Storper, 1987: 216; Digiovanna, 1996: 375 and Cooke, 1983:158). Each broad *epoch* of growth in capitalism tends to be associated with, and based upon a particular *ensemble* of dominant production sectors (Tickell and Peck, 1992 and Hassink, 1997: 8). Briefly, the epoch of growth associated with each of these ensembles is typified by a *regime of accumulation* which mark stable periods of capitalist growth. Each regime of accumulation is in turn sustained by a set of macrosocial and political arrangements that can be called a *mode of social regulation* which ensures the proper functioning of the economic system and its reproduction over time (Hassink, 1997: 8; Digiovanna, 1996: 375 and Tickell and Peck, 1992).

In to the put by the theory, these 'growth peripheries' intensify the imbalance between the new center and the periphery even more as the emergent spatial division of labor, based on unequal exchange between regions with different levels of technical development provides the setting for unequal exchange in terms of differences in wage levels (Sternberg, 1996: 524 and Cooke, 1983:159).

[11] "The nation-state is seen to withdraw progressively from intervention in the wage labor relation, in planning and physical social investment and in the process of supranational economic co-operation. In contrast, the regional and local state is endowed with a considerably enhanced role in direct economic intervention, bargaining with local firms and unions and promoting innovation. ... It is one thing to claim that the contemporary capitalist nation-state has become disempowered by the internationalization of capital and weakened by the concommitment of the Fordist-Keynesian 'social contract' but it is quite another to claim that local and regional states are in any way beginning to expand into this vacuum." (Tickell and Peck, 1992: 204)

[12] According to the theory of cumulative causation, 'once set in train *agglomeration* process becomes cumulative as trade in the less developed regions comes to be dominated by the commodities marketed from the development centers' (Cooke, 1983:120).

[13] The basic idea *of growth pole* focused on a propulsive industry and its linked industries that grow faster than the rest of the economy because of modern technology and high rates of innovation, income-elastic demand for their output in national and international markets, and large multiplier effects (Echeverri-Carroll, Hunnicutt and Hansen, 1998: 722, Harrison, 1992: 473 and Richardson, 1984:19). For Perroux, what lifts an economy out of the 'stationary state' in the long run is Shumpeterian innovation (Harrison, 1992: 473). According to the growth pole theory, certain poles from which centrifugal forces emanate and to which centripetal forces are attracted exist (Cooke, 1983 and Hermansen, 1975). Entrepreneurial talent and innovations constitute the prime causal factors behind economic progress of growth pole. Although the achievement of external economies of scale of growth pole is not conditioned by a territorial agglomeration of industrial complexes, according to Perroux, the growth potential and competitiveness of growth poles can be intensified by territorial agglomeration (Asheim, 1997: 7-8).

[14] Maillat et al. stress the close link between milieu and innovation networks taking the example of Swiss Jura Arc. They argue that innovation networks are formed on the basis of pre-existing relations which themselves make up the milieu. "The latter participates in the emergence of innovation networks and is involved in their dynamic by providing the elements needed for the projects to materialize. It should, however, be noted that the networks in turn enrich the milieu, in that learning processes they engender contribute to the increase in the creative capabilities of the milieu. Through a process of learning by networking, networks permit a deepening and a broadening of the know-how of the different partners, who will in turn enrich the resources of the milieu. In other words, an interaction phenomenon links the innovation networks and the milieu." (Maillat et al., 1995: 261)

[15] What is called operators allows the individual firms to overcome the inescapable presence of uncertainties of all kind (Camagni, 1991).

[16] Camagni identifies that in their economic behavior and decision-making processes firms face five important kinds of uncertainty: (1) static uncertainty coming from an 'information gap' linked to the complexity, the width and the cost of the information collection activity; in the real world, the firm is usually left with a huge lack of relevant information on the occurrence of already known events; (2) static uncertainty, coming from an 'assessment gap' linked to the difficulty of inspecting ex-ante the qualitative, mainly hidden, characteristics of inputs, components, production factors, technical equipment; (3) static uncertainty coming from a 'competence gap', linked to the firm's limited ability of processing and understanding available information; the existence of technical problems whose solutions are obscure are an example of this wide category of situations; (4) dynamic uncertainty coming from the so called 'C-D gap' (competence-decision gap); uncertainty in this case involves the impossibility of precisely assessing the outcomes of alternative actions, even in presence of full and free information on past events, due to the complexity of the decision problems themselves and inherently imperfect foresight. The probability of choosing a wrong or inferior technology is therefore large; (5) dynamic uncertainty coming from a 'control gap': the outcomes of present actions depends

in fact on the dynamic interaction among independent decisions of many actors on which the firm has by definition a minimum control. (Camagni, 1991: 126)

[17] For further discussion of this issue see Florida (1995) and Hassink (1997). Florida considers learning regions as the spatial outcome of grand societal changes from mass production to knowledge-based capitalism. According to Hassink, in fact, what he calls a shift from mass production region to learning region, other scholars (Piore and Sabel 1984) have called a shift from Fordist to post-Fordist economic and social systems or, confined to economic changes, from mass production to flexible specialization. According to Florida (1995: 527) 'regions are becoming focal points for knowledge creation and learning in the new age of global, knowledge-intensive capitalism, as they in effect become learning regions. These learning regions function as collectors and repositories of knowledge and ideas, and provide the underlying environment or infrastructure which facilitates the flow of knowledge, ideas and learning". Globalization is not a threat for regions, instead 'learning regions are increasingly important sources of innovation and economic growth, and are vehicles for globalization' (Florida 1995:52). Florida (1995: 532, 534) clearly sees similarities between the characteristics of the new generation of regions and the new generation of companies in knowledge-based capitalism as he states: 'in effect, regions are increasingly defined by the same criteria and elements which comprise a knowledge-intensive firm - continuous improvement, new ideas, knowledge creation and organizational learning ... Learning regions must develop governance structures which reflect and mimic those of knowledge-intensive firms, that is co-dependent relations, network organization, decentralized decision making, flexibility, and a focus on customer needs and requirements'.

As Hassink notes, Asheim (1997) also consider learning regions or regional innovation systems as the outcome of the change from the linear innovation model to a bottom-up interactive innovation model. The linear innovation model was part of the Fordist industrial and societal organization, in which formal knowledge, research-based and codified knowledge, large enterprises, national systems of innovation have dominated. The bottom-up interactive innovation model is adapted towards the post-Fordist learning economy. This model is dominated by the techno-economic paradigm of information and communication technologies (information, computers, telecommunication). Untraded interdependencies, which include the regionally embedded labor market, tacit knowledge, knowledge system, norms, social conventions and values and institutions, are seen as important factors for the process of learning. These untraded interdependencies attach to the process of economic and organizational learning and co-ordination and where they are geographically concentrated the region is a key, necessary element in the 'supply architecture' for learning and innovation (Massey, Quintas and Wield, 1992; Storper 1995 and Asheim 1997). This school of authors does not see innovation as a linear process, but as an interactive process in which interactive learning and feedback effects are constantly taking place (Hassink, 1997: 3).

[18] Discussions going on about the relationship between entrepreneurial learning, innovation and spatial proximity emphasize that firm innovation processes increasingly take place in interaction with other organizations, be it with other business partners, such as customers, suppliers or competitors or with public research establishments (PREs), higher education institutes (HEIs), technology transfer agencies etc. Innovation processes hardly never take place anymore in isolation. The information and knowledge that is needed for innovations can be collected both within and outside the firm. Due to an increasing cutthroat competition and shorter product life cycles firms, and particularly small and medium-sized enterprises (SMEs), are increasingly dependent on information and knowledge sources that are available outside the firm. According to this perspective learning regions is nothing more than interorganisational learning by actors that are linked to their location. They could not achieve the same learning at another location in the way they achieve it now. (Hassink, 1997: 4)

In learning regions one can therefore observe something like a collective tacit knowledge which is linked to the location because of the coinciding of social, cultural and spatial proximity (Morgan 1997). *This collective tacit knowledge in regions can be equated with Storper's (1995) term untraded interdependencies'*. This kind of tacit knowledge in regions cannot only be stimulative for innovation processes in companies and interactive learning between them, it can at the same time also lead to path dependence and political and cognitive lock-ins. (Hassink, 1997: 6)

[19] Disembodied knowledge can be both tacit and codified. However, such knowledge is generally highly geographical immobile. Thus, some codified knowledge can be localized rather than placeless

learning. This implies that the adaptability of this localized form of codified knowledge is dependent upon, and limited by, contextual, tacit knowledge of, for example, specific industrial districts. (Asheim, 1997: 9-10) Localized, codified knowledge can provide the basis for 'learning by interacting' (e.g. user-producer relationships), which represents a more advanced form of learning than 'learning by doing' and 'learning by using', as it can not primarily be based on tacit knowledge. According to the importance modern innovation theory places on interactive learning, it has the potential of producing radical innovations in addition to incremental ones. (Asheim, 1997: 10)

[20] Hermansen notes that space is used as an input in production and it represents an obstacle to human interaction, which increases with the distance. He distinguishes between space utilizing (agriculture), space using (industrial plants) and space reducing (transportation) activities. The essential difference between space-utilizing and space-using, point-located activities is that while the latter exposed to forces of mutual attraction, this is not the case for the former (Hermansen, 1975:304). Space-reducing activities reduce the impact of space upon human interaction. They are intended to overcome obstacles to interaction arising from the dispersion of human activities (Hermansen, 1975:305).

[21] Space creating refers to the fact that industries produce economic space rather than being hostage to the pre-existing spatial distribution of suppliers and buyers (Sternberg, 1996: 524 and Thompson, 1989: 132).

[22] In both conventional (Perroux) and Schumpeterian-based (Porter) regional economics, agglomeration economies is understood as agglomerated external economies, normally specified as 'localization economies', which accrue to all units within a given sector located in the same agglomeration (Hermansen, 1975: 305; Fuellhart, 1999: 42; and Glasmeier, 1999: 77), and 'urbanization economies', which accrue to all units in all sectors in the same agglomeration (Hermansen, 1975: 305; Fuellhart, 1999: 42; and Glasmeier, 1999: 77), respectively (Asheim, 1997: 7-8). In Marshall's view, external economies are obtained through the geographical concentration of groups of vertically and horizontally linked small firms ('localization' economies). In contrast to Perroux, Marshall attaches a more independent role to agglomeration economies. The 'Marshallian' view of the basic structures of industrial districts expresses the idea of 'embeddedness' as a key analytical concept in understanding the workings of the districts. It is precisely the embeddedness in broader socio-cultural factors, originating in precapitalist civil societies, that represents the material basis for Marshall's view of agglomeration economies as the specific territorial aspects of geographical agglomerated economic activity, which concern the quality of the social milieu of industrial districts, and which only indirectly affect the profits of firms. Among such factors, Marshall emphasizes, in particular: the 'mutual knowledge and trust' that reduces transaction costs in the local production system; the 'industrial atmosphere' which facilitates the generation of skills (tacit knowledge) and (social) qualifications required by the local industry; and the effect of both these aspects in promoting (incremental) innovations and innovation diffusion among SMEs in industrial districts. By defining agglomeration economies as social and territorial embedded properties of an area, Marshall abandons 'the pure logic of economic mechanisms and introduces a sociological approach in his analysis'. This mode of theorizing is fundamentally different from the one found in conventional regional economics or in any other neoclassical-based agglomeration theory. (Asheim, 1997: 8)

[23] Although one can undertake something within the region to avoid the development of a sclerotic milieu, the dramatic reduction in demand for a cluster's product can turn a structurally strong regional economy into a weak one over night. This has been shown in defense-dependent regions of Massachusetts and southern California in the USA. This demonstrates how dependent regional economies can be on conditions that mainly lie outside the regions, such as global competition.

[24] "One has to distinguish between tacit and codified knowledge. Innovation-relevant information is typically not a publicly available good, but private tacit knowledge; those parts of personal knowledge as well as personal skills that cannot be communicated in an unpersonal way. Only through personal, communicative interaction between actors there are possibilities to exchange, understand and to apply this kind of information." (Hassink, 1997: 5)

[25] The regulation of the cartel was so strict that Swiss manufacturers could buy only from Swiss component producers, and component producers could sell only to Swiss firms (Glasmeier, 1991: 472). In addition further limit was on the competition, government regulated the sale of machinery

and Swiss firms were restricted from setting up production in other countries (Glasmeier, 1991: 472).

[26] According to Glasmeier *Network rigidities hamper industry response* (Glasmeier, 1991: 472). Glasmeier argues that; "Internal industry organizations and cultural impediments hampered a rapid response to the electronic watch. ... With electronics watches there were fewer parts to be manufactured. Consequently the time needed to make a watch dropped dramatically. ... Ironically, product variety further hampered the industry. ... the manufacturing cycle had to be managed across a wide range of products from tool making to product assembly. Manufacturers had no choice but to focus on quality to differentiate themselves from the assemblers. ... Low volume of output led to high prices. The effort required to overcome technological deficiencies associated with quartz technology required an industry-wide response. ... no single firm could afford the costs of developing such an uncertain technology. ... This new form of collaboration created serious problems, because no single firm could appropriate the fruits of collective research and translate it into a competitive advantage to capture new markets." (Glasmeier, 1991: 481)

[27] Mechatronics refers to the combination of mechanical and computer technologies. Mechatronic products include consumer goods like watches, cameras, and home appliances and industrial goods like industrial robots and machine tools (Florida and Kenney, 1990: 80).

[28] Optoelectronics refers to the combination of computer and video technologies (Florida and Kenney, 1990: 80).

[29] Systems technologies refers to the combination of a variety of technologies in a workable system. Systems technologies products include television, telephones, and electrical transmission technologies (Florida and Kenney, 1990: 80).

[30] Four different type of flexibility can be identifiable from the point of view of labor market; time, organizational, functional and pay flexibility (Massey, Quintas and Wield, 1992). In high-tech regions, generally there is no formal time recording of attendance of the staff. Staff work on projects basis and there is a low level of supervision on them. But Massey et al. identify that there are some exceptions. In the UK those directly involved with work for clients and maintenance engineers together with shop-floor production operators were subject to the most time recording. A further distinction is between large and small firms; Establishments owned by larger firms had a higher level of monitoring of their employees than did independent firms (Massey, Quintas and Wield, 1992: 96). Massey et al. argue that high-tech firms use flex-times but workers in general overcompensate for this flexibility.

> "Key people are often still working at 10, 11, 12 and even 2.00 a.m. At the top level the barrier between work and play has disappeared. *They* did it for love, not money *and they* were not paid overtime. *If* the project was exciting, they would work late into the evening." (Massey, 1992; 95)

On the issue of flexibility, according to Massey et al. it is the flexible pay of which there is little evidence that high-tech firms make use (Massey, Quintas and Wield, 1992: 101). However, they justify that some jobs have intrinsic interest and the possibility of high pay-offs and of career progression. For people with this kind of job the extra commitment is not only to the company; it is also to the benefit of their own careers (Massey, Quintas and Wield, 1992: 112). "Again, however, as in the case of timekeeping, there were differences within the staff, those establishments which did pay overtime did so to two distinct types of employee: those involved in a direct servicing role, such as maintenance and sales engineers, who are called out on an irregular basis, and – much more predominantly – those in 'lower grades'. ... Only one science-park establishment mentioned a profit-sharing scheme as part of moves towards flexible payment systems, a figure which is very surprisingly low, given the image of entrepreneurial spirit associated with science-park high-tech firms." (Massey, Quintas and Wield, 1992: 102)

[31] "The early 1920s was a period of great instability in the watch industry. ... The severity of the crisis forced family businesses to take drastic steps simply to reduce inventory. ... This unprecedented threat resulted in a call for industry regulation, and a cartel was formed." (Glasmeier, 1991: 471) "During the 1920s various associations were created to represent the interests of industry members. The Swiss Watch Industry Federation (FH) was organized to govern both firms assembling watches from component parts and the few firms with integrated manufacturing operations." (Glasmeier, 1991: 472)

[32] For a long time period Swiss watch manufacturer had benefited from the constitution of Cartel. "*But* in the early 1960s three decades of stability once again gave way to uncertainty. ... Reasons for industry discontent were numerous. The more profitable and better run firms lobbied against the cartel arguing that it protected firms that were producing low quality watches." (Glasmeier, 1991: 472) "The new law took effect in 1962, but it was not until the early 1970s that restrictions on watch manufacturing were entirely eliminated. As expected, the watch industry underwent a series of unprecedented mergers. The healthier and larger establishments joined forces to match the sizes of their Far East Asian and American rivals. ... The remainder of the industry was made up of hundreds of small companies assembling and selling watches." (Glasmeier, 1991: 473)

Shortly the early development of Swiss Watch industry represents a high government regulation on exports and imports for watch manufacturing industry (Glasmeier, 1991). The initial result of this was high benefits to overall industry but the rigidities of government regulation prevented the transition to new technology oriented watch manufacturing (Glasmeier, 1991).

[33] Indeed, the only three Taiwanese companies producing integrated circuits all have Government participation, and all three are located in Hsinchu: besides ERSO, they are United Microelectronics Corporation (32 percent government owned) and TSMC (47 percent government owned) (Castells and Hall, 1994: 102-103). In fact both were developed by engineers originally trained at ERSO (Castells and Hall, 1994: 102-103).

[34] After the II World War, Japanese Government adopted serious economic growth policies. During the rapid economic growth period of Japanese, regional income differentials reached their highest level (Abe and Alden, 1988: 436, Fujita, 1988: 585, Masser, 1990: 41-46 and Castells and Hall, 1994: 112-115). To overcome this problem, Japanese Government employed two particular strategies; the development of growth poles in local regions (i.e. regional growth poles other than the three Metropolitan Areas focused upon Tokyo, Osaka and Nagoya); and legislation to control industrial location and development (Abe and Alden, 1988: 436, Fujita, 1988: 582, Masser, 1990: 41-46 and Castells and Hall, 1994: 114-115).

The first national plan called for the intensification and concentration of public investment in the Pacific Rim, and adopted a growth pole development policy to encourage the dispersal of industry and the development of regional areas in order to reduce regional income disparities (Fujita, 1988: 582, Castells and Hall, 1994: 114-115 and Abe and Alden, 1988: 437). In the first comprehensive national development plan of 1962 the first and best known of measures taken is the New Industrial Cities (NIC) program which initially designated six industrial regions and fifteen growth poles (cities) throughout Japan in accordance with the strategies laid down (Castells and Hall, 1994: 114-115, Masser, 1990: 46 and Fujita, 1988: 582). These local cities were eager to invite new industries to their regions, providing large-scale infrastructure for heavy and chemical industries while in turn expecting tax revenue increases from the industries in the future (Fujita, 1988: 582).

There is some speculations over the result of this first national plan. On the one hand Fujita argues that the result of this industrialization was rapid urbanization in already crowded sections of the three metropolitan areas and the Pacific coast (Fujita, 1988: 582). According to him, **uneven development** between the three metropolitan areas (and the Pacific coast) took place during the high economic growth period (1960-75), with the rest of Japan suffering from depopulation and local economic decline (Fujita, 1988: 582). On the other hand, Abe and Alden claims that during the 1960s and early 1970s **regional income** disparities declined markedly (Abe and Alden, 1988: 437). According to them this followed a significant shift of manufacturing employment from urban to rural regions (Abe and Alden, 1988: 437). However, they also recognizes that by the latter 1970s regional income disparities began to widen and present a challenge once again to regional development planning (Abe and Alden, 1988: 437).

The second Comprehensive National Development Plan of 1969 aimed to build a national network of expressways and Shinkansen (bullet trains), plus large industrial projects; in the mid-1970s, Prime Minister Kakuei Tanaka aggressively implemented this, with plans to link Japan by a network of bullet trains, highways, telecommunications networks and new information cities (Castells and Hall, 1994: 114-115). "But neglected by both local and central states, local residents started mass protest activities, initiating direct action against the central and local states because of their disillusionment with the ineffectiveness of customary structures and parties and the established organizations like labor unions. Citizen movements protested about the high growth priority industrial policy, and eventually generated a local opposition movement which was frequently aligned with the Socialist Party, the Communist Party and centralist political parties. Progressive local governments flourished throughout the 1970s, with local politics increasingly being opposed to the national industrial policy and taking initiatives in social and welfare programs. Meanwhile, industrialization and urbanization brought a shrinkage in the hitherto secure electoral base of the Liberal Democratic Party at the national and local level, and the LDP was forced to shift its policy emphasis from economic growth to social and welfare programs." (Fujita, 1988: 582-583) "In most policy areas, the state has displayed increased sensitivity toward social welfare, the environment and living conditions for the individual citizen." (Fujita, 1988: 584) In 1977, the Third Comprehensive National Development Plan aimed to improve the quality of life in certain designated areas (Castells and Hall, 1994: 114-115).

[35] In Japan, MITI (Ministry of International Trade and Industry) charts the broad direction of advance for the economy and for technology and give companies sufficient confidence in this vision to make their own long-term investments in research, development, software, equipment and training (Freeman, 1988: 331-334, 344).

[36] "Terman reportedly used the government and academic contacts he had made during the war to attract a large proportion of the Pentagon's research and procurement dollars to the Stanford area. During the 1940s and 1950s a number of already well-established electrical- and electronics-related firms also moved operations into Santa Clara County to take advantage of the proximity to the war-related aircraft, missile and aerospace markets. The development of the Stanford Industrial Park in the early 1950s represented the culmination of Terman's vision of an academy-industry partnership. Leases in the park were granted only to high-technology firms which might be beneficial to Stanford university." (Saxenian, 1985: 24 and Castells and Hall, 1994: 16-17)

[37] "In 1955, gifts from private corporations to Stanford had reached half a million dollars annually; through Terman's careful attention to faculty building, Stanford rapidly attained the reputation as one of the best electrical engineering programs in the country." (Saxenian, 1985: 23)

[38] According to Saxenian Silicon Valley needs public forums for debating regional industrial strategies and defining institutions to ensure the flexibility and dynamism of its networks of specialist firms. "These institutions might ensure that the region's firms: have access to long-term financing and recent research findings; coordinate **technical and managerial training programs** and basic research projects; provide export and marketing assistance and global information-gathering services; organize data collection and analysis of the region's fast-changing industrial base; and establish forums for joint assessment of sectoral or regional problems. With time, they would provide a forum for defining and coordinating responses to external developments such as unanticipated technical advances and competitive challenges from outside of the region. ... To begin such a dialogue requires that Silicon Valley's entrepreneurs and managers overcome their deep-seated distrust of the public sector and recognize the social basis of their success." (Saxenian, 1990: 106)

[39] The aim of JÆRTEK which was established in 1987 is to offer training preparing workers and pupils in technical schools for the advanced industrial work of tomorrow, and to secure the competence basis for a continued, rapid technological development. To achieve this, the first complete CIM-equipment in Norway was installed in JÆRTEK. Later the CIM concept has been diffused to several other member firms, among them Kverneland, which used the investment in CIM to combat the reduced demand for agricultural machinery in Europe through increased productivity and competitiveness. This strategy resulted in a strong increase in the turnover in 1994 and 1995, which made Kverneland the largest producer of ploughs in Europe. (Asheim, 1997: 20)

[40] In Baden-Württemberg federal government is supportive of R&D and technological diffusion but it is the regional Land government that has been most pro-active, especially in areas of education, training and network development. Yet, the Land government has been slow in responding to citizens' concerns about the pace of development. Regional training centers have also been developed in Emilia-Romagna (Digiovanna, 1996: 383).

[41] "The specific characteristic of microtechnologies is that they call for a substantial effort in terms of research and training, requiring in this field a sound infrastructure on which industry can rely. ... In

this context the merging and conversion of watchmaking laboratories to form the Swiss Electronics and Microtechnological Center (CSEM SA) have undeniably helped to relaunch the local dynamic. ... it is the result of a merger of three watchmaking laboratories. The object of merging the strengths and resources of the three laboratories was to enable industrialists to benefit more widely from the technological contributions of microelectronics and microtechnologies." (Maillat et al., 1995: 255)

[42] A major factor behind the location of the Park in Hsinchu seemed to have been the presence here of the Industrial Technology Research Institute (ITRI), a major technology transfer institution created in 1973 by the Ministry of Economy and fully funded by the National Science Committee. ITRI includes five research organizations, the most prominent of which is ERSO (Electronics Research and Service Organization), an institution that has played a decisive role in Taiwan's technological development in electronics. In 1973 ITRI bought integrated circuit design technology from the American multinational RCA. The aim was to transfer design capability to Taiwanese companies; a senior executive of RCA was recruited by the Taiwanese Government to supervise the project. Forty young Taiwanese engineers were sent for 18 months to RCA centers in the United States for advanced training. The first group of these engineers came back to Taiwan in 1974, and that very year they designed the first integrated circuit to be entirely made in Taiwan. (Castells and Hall, 1994: 102-103)

ERSO started manufacturing chips for watches, later upgrading production to customized chips for calculators and telephones. In the late 1980s, ERSO was manufacturing chips for microcomputers and peripherals, consumer electronics, and telecommunications, including the design of memory chips such as high-speed RAMs, and MOS RAMs. ERSO was used deliberately by the Government to diffuse microelectronics technology among Taiwanese firms, by organizing seminars and training programs where ERSO's technology was communicated to private firms. In addition, ERSO encouraged some of its engineers to leave the Institute after some years of training and to set up their own companies, in some cases locating in the new Industrial Park. (Lin, 1997: 263 and Castells and Hall, 1994: 102-103)

In Hsinchu, the Government also offers on-the-job training programs for young engineers belonging to the firms located in the Park, through grants from the National Science Council to undergo training at ITRI or at the two universities located nearby (Castells and Hall, 1994: 102). "Firms in Hsinchu entertain close contacts with the two major universities in the area. ... There are a number of programs involving the two universities and the companies in the Park. For instance, the companies organize workshops to inform university students about recent developments in high-tech industry and provide the universities with advanced equipment and experience in industrial production; the universities hold open house sessions to inform the companies of their research achievements; the universities also provide training programs for the employees in the Park." (Castells and Hall, 1994: 106)

[43] "A key component of Nagaoka's technopolis strategy is the Nagaoka Technopolis Foundation which was set up in 1983 immediately prior to technopolis designation. ... The most important of the R & D promotional activities are the provision of very low interest guarantees and loans to enterprises developing advanced technology in the region. In addition the Foundation also purchases state of the art equipment such as a computerized numerically controlled milling machine for use as a shared facility by local firms. ... it supports the provision of technical guidance by university staff to local firms in connection with new product development; an extensive program of seminars by leading technologists from other parts of Japan in the fields of new materials; computer-aided engineering, factory automation and biotechnology; and the provision of on-line access to nationally held data bases on industrial patents and organizations." (Masser, 1990: 50)

[44] "The prefecture established an Electronics-Aided Machinery Research Center and a Precision Machinery Technology Research Center within the prefectural research facilities in 1983 for research and development of electromechanical engineering systems for the local small and medium electronics equipment industries. These centers train companies to respond effectively to new industrial fields." (Fujita, 1988: 580)

The Kumamoto Technopolis has three central organizations for its development: The Kumamoto Technopolis Foundation, the Applied Electronics Research Center, and the Kumamoto Technopolis Center. The Kumamoto Technopolis Foundation was the core organ established in 1983 with funding support from businesses like NEC-Kyushu, Mitsubishi Electric, Tateishi Electric, and other local business, community and government agencies (the prefecture, Kumamoto City, and other cities and towns). The foundation members include academics from Kumamoto University and Tokai University and local private and public sector representatives (Kumamoto Prefecture, 1984). ... The Applied Electronics Research Center opened in 1985. It focuses on technological development of automation, computers and data processing. It has three main research themes: its own research, which is long-term research to upgrade local industries; commissioned research from the private sector; and joint research with industry, universities and the government. Facilities and equipment in the center are also offered to universities and the private sector for rent; and the center also trains researchers from universities and industry with two-year financial support. In sum, the center's role is research and development for local industries supporting technological development and the advancement of the level of technology, manpower and information. The Kumamoto Technopolis Center is under construction. With the completion of building, the center will be a place for the exchange of technology and information on local industries. The center provides the latest information on technology and market through KINS (Kumamoto Information Network System), Techno-Mart and Teletopia (a project to develop the telecommunication system by the Ministry of Post and Telecommunication). The center also provides manpower training for local small and medium industries for software engineering (Kumamoto Prefecture, 1985h). (Fujita, 1988: 581)

[45] "There is a strong institutional funding in Japan but it is not without a price. Small firms are often required to send representatives to training seminars on small business management and to open their books to lending institutions. For example, in 1984 approximately 68,000 people were trained by the Institute of the Small Business Corporation (1987a). ... By Western standards, state involvement in small businesses' affairs is significant. ... Japanese programs assisting small business are extensive. ... the Japan Small Business Corporation ... assists small businesses in upgrading operations. This program brings together groups of small firms and trains them in modern business practice. ... The Japan Small Business Corporation attempts both to strengthen small businesses' abilities to export products and link up with large assembly firms, and to maximize the economies of scope found among groups of small businesses (1987b). In 1989, programs were introduced to help firms contend with problems arising from endaka and the internationalization of the Japanese production system. Small firms receive assistance in shifting production offshore, maintaining links with subcontracting firms and exporting to other countries (MITI, 1987)." (Glasmeier and Sugiura, 1991: 406)

[46] Economic development plans for 5 years' periods for the whole of the nation.

[47] Although, these five projects are labeled as being technoparks, they can be rather considered as being incubation centers as they have limited physical development areas and financial resources with relatively low numbers of high-tech firms.

[48] The history of Turkish Free Zones goes back to 1927. Although, 'Free Region Law' for the year 1927 and 'Free Zone Law' No: 6209 for the year 1953 had come into force, the integration of free trade zones into the economic and commercial life as an institutional body was realized by the 'Free Zone Law' No: 3218 for the year 1985 (Tekeli and İlkin, 1987: 90-101 and Pakbeşe, 1996: 75). It came into force on June 3, 1985.

'Free Zone Law' No: 3218 for the year 1985 encompasses the matters related to the establishment of free zones (The Turkish Free Zones Legislation and Regulation, 1996: 1); the determination of their location and boundaries; their management; the scope of their activities; their operation; and the establishment of the installations and facilities within the zone; with the objective of increasing export-oriented investment and production in Turkey; accelerating the entry of foreign capital and technology; procuring the inputs of the economy in an economic and orderly fashion; and increasing the utilization of external finance and trade possibilities.

According to the Article 6 of the Law, free zones are deemed to be outside of the customs borders. According to the Article 4 of the Law, all kinds of industrial, commercial and service activities approved by the Economic Affairs Supreme Coordination Council may be carried out within the free zones. 'Free Zones Governing Regulation' which come into force on March 3, 1993 (Official Gazette numerated 21520) set out principles pertaining to the establishment, administration and management of the free zones and to the collection of revenues and making of expenditures for and from the 'Free Zones Establishment and Development Fund', founded in accordance with the Article 7 of the said law, together with other matters related to the said fund.

[49] There are currently four firms supported by TDTC of AFZ. One of them is a joint venture with Vakıf Risk and produce bio-technological products. Founders of the firm have philosophy degrees in science (MRS). Another firm is a software developer firm established by two technical-high-school graduates. The remaining two firms were established by AFZ Inc. One of them is a joint venture with a Sweden firm and produces steel arcs. The other firm produces self-supporting construction panels in order to solve the housing problem of Turkey.

[50] They are successful firms producing high-tech electronic products or services. Vestelkom is the most famous example of how a small high-tech firm succeeded to commercialize its know-how. At the beginning the firm was a small electronic firm but later it was bought by Vestel and began to produce remote controllers and decoders for Vestel TVs. They also produce their own TV. Another firm is NKL Electronics. It was originally established by a Turkish Entrepreneur in Germany in 1983. They produce and develop choke coils for interference suppression and for noise immunity (against electromagnetic waves in free space), and high-frequency transformators. They provides also foreign and domestic firms with laboratory services for CE Conformity Europe Standards. They have 600-700 customers all around the world and 10-15 customers in Turkey. Another firm is repairing the electronic cards of Siemens. It is established by an electronic engineer who previously worked for Siemens-Nixdorf. Specific cards of Siemens all around the world are sent to this firm to be repaired.

[51] STIRC of Ege University was established in 1994 in order to support the R&D activities and facilitate the cooperation between university and industry. The center has a $1000m^2$-three-floor-building fully equipped with air conditioners, a generator and internet links. The center has a secretarial office equipped with computers, printers, scanners and photocopy machines; a fully-equipped-50-people-capacity-conference-hall and a small reference library which is still being constituted. It has also 19 laboratories equipped with standard equipments. In addition to this, there are lots of other special devices either owned or used by the center. There are total 11 personnel composed of 5 professional staff and 6 assistant staff. Moreover, academicians employed at Ege University constitute a potential for the R&D activities conducted in the center. In addition to the facilities provided by Development Foundation of Ege University, the center also benefits from the supports of national and international projects together with the supports given by the firms on the base of projects. Furthermore, the center also creates its own financial resource by providing firms with consultancy services.

[52] In fact, this project resembles a technopark rather than a technopolis but within the thesis the original labeling, Technopolis, is used since the project is formally labeled as Technopolis.

[53] It will occupy 42 hectares of land. High-tech R&D activities, telecommunication-data processing and design centers together with incubation center, depots, offices, light assembly lines and university patent office will be all located in the science park.

[54] It will occupy 25 hectares of land. Business park will be an interface between real life business atmosphere and scientific activities. Offices equipped with high-tech telecommunication services and facilities will be located in the business park. The park will be near to the green belt, shopping centers, restaurants, banks and metro station. And in this way, it will provide firms with an attractive environment.

[55] It will occupy 95 hectares of land. It will be near to the working areas at the south of the technokent. Sports facilities, some of the restaurants and banks together with health, education and telecommunication centers will be located in the settlement area.

[56] Middle East Technical University (METU) and Turkish Scientific and Technical Research Council (TSTRC) have signed a protocol on 30.10.1984 to establish an institute on electronics in the campus of METU. The related regulation was published in the State Official Gazette on 15.02.1985 and Ankara Electronics Research and Development Institute was founded and located at the Department of Electrical and Electronics Engineering. The organizational structure of the Institution has been dramatically changed since 14.6.1991 and the project groups have become the main structural part of the organization. On 26.5.1995, the Institute's working field was extended by a change in its Regulation and Institute's name was changed as Information Technologies and Electronics Research Institute.

Information technologies include data gathering, data processing, data organizing, data storage and access, and all other related technologies. Therefore, the major interests of the Institute are in the fields of electrical and electronics engineering, computer science and engineering and, industrial engineering. The Institute carries out research and studies mainly on computer hardware and software, electronics and communications, image processing and coding, the power and control systems related to the information technology. There are 16 project groups working on these topics in the Institute, currently. These project groups are; Intelligent Energy Conversion; Computer Graphics & V.R.; IT Standards Monitoring ; Image Processing; Power Systems; Speech Processing; Internet and Telematic Services; VLSI and Electronics Design Group; Information Security and Electronic Commerce Group; IT Hardware Development; IT Software Development; Communication Systems; Remote Sensing and GIS; Satellite Technologies Group.

[57] Marmara Research Center was established in 1972 to conduct research and development as an arm of TSTRC which is the primary organization for science and technology creation and management in Turkey. Located at a 750 hectare (3000 acres) site near the town of Gebze about 50 km East of central İstanbul, the center is presently staffed by some 750 personnel, with 'researchers' making up slightly more than 50 %. At the present the areas of scientific and technological activities are: Basic Sciences: mathematics, physics, chemistry and earth sciences; Informatics: software engineering, artificial intelligence, robotics, networks; Electronics: cryptology and semiconductor research lab/pilot production facility; Genetic Engineering and Biotechnology; Metrology: national labs for primary physical standards; Materials Science: ceramics, advanced composites, precision casting; Food and Nutrition Technology; Chemical Engineering; Environmental Engineering; Energy Systems and Space Technology.

[58] However, if the items listed as following are to be imported within the framework of an investment encouragement certificate, Custom Tax and the Mass Housing Fund will be charged at the rate set forth in the prevailing Decree on Import Regime; automobiles; buses (including double-decker buses); separate chassis (trailer mountable); trucks (excluding ones which have environment safety standard engines, respectfully ones which have Euro I and/or Euro II Standards); trailers (to be pulled by separate chassis trucks) (excluding ones which have refrigeration units); furniture yachts (including motorboats); trucks (excluding off-road, and rock carrying type heavy-duty special purpose dump-trucks which cannot operate on public roads); transmixers ; uninterrupted power sources; cement centrals forklifts; cement pumps; construction equipment; kitchenware and tableware products made of porcelain and ceramics.

[59] The Turkish tax regime can be classified as: Income Taxes (Corporate Income Taxes and Individual Income Taxes), Taxes on Expenditure (Value Added Tax, Banking and Insurance Transaction Taxes, and Stamp Duty) and Taxes on Wealth (Inheritance and Gift Taxes, and Property Tax)

Income taxes in Turkey are levied upon the income, both domestic and foreign, of individuals and corporations resident in Turkey. Non-residents earning income in Turkey through employment, ownership of property, carrying on a business or from other activities giving rise to income are also subject to tax, but only on their Turkish derived income. For tax purposes, companies are grouped as limited liability companies (corporations and limited companies) and personal companies (limited and ordinary partnerships). Corporate tax applies to limited liability companies. State economic enterprises and business entities owned by societies, foundations and local authorities are also subject to corporation tax. The limited tax liability covers trade or business income from a permanent establishment, salaries for work done in Turkey (regardless of where paid or whether or not remitted to Turkey), rental income from real property in Turkey, Turkish derived interest, and income from the sale of patents, copyrights and similar intangible assets.

Taxes On Expenditure: Deliveries of goods and services are subject to VAT at rates varying from 1% to 23%. The general rate applied is 15%. Intercompany interest charges are subject to VAT at 15%. The VAT rate on most leased assets is 1% with the exception of 23% on leased cars and 8% on other leased land transport vehicles. Lease contracts are exempt from all types of taxes, duties and stamp taxes. VAT is charged on imports t normal rates. Banking and Insurance company transactions remain exempt from VAT, but are subject to a Banking and Insurance transaction tax. This tax applies to income earned by the banks, for example on loan interest. Stamp duty applies to a wide range of documents, including contracts, agreements, notes payable, capital contributions letters of credit, letters of guarantee, financial statements and payrolls. Stamp duty is levied as a percentage of the value of the document.

Taxes On Wealth: Items acquired as gifts or through inheritance are subject to taxes between 4% and 30% of the item's appraised value. Tax paid in a foreign country on inherited property is deducted from the taxable value of the asset. Inheritance tax is payable over the period of five years and in two installments per year. Property taxes are paid each year on the tax values of land and buildings at rates varying from 0.3% to 0.6%. In the case of the sale of property, a 4.8% levy is paid on the sales value by both the buyer and the seller. The rate is reduced to 2.4% if the property is contributed as capital-in-kind.

[60] Prepared by Undersecretariat of Foreign Trade and published in the Official Gazette No.22168, dated January 11, 1995.

[61] SMIDO EICC aims to offer enterprises fast, accurate and cost-effective information as well as business cooperation services, functioning as the national focal point of; Business Cooperation Network (BC-NET 90521), Correspondence Centers of Bureau de Rapprochement des Entreprises (BRE 477), Euro Info Center Network (EICC TR-701)

SMIDO EICC; acts as a communication channel between local and foreign companies, providing information of direct relevance to business via on-line and off-line information sources; informs SMEs on Turkish Manufacturers either using its own database (which currently comprises 11000 up-to-date firm profiles) or establishing contacts with related organizations like chambers of commerce & industry, vocational organizations etc.; compiles necessary information from related organizations and makes available basic data on the Turkish market environment, including import and export figures and consumption trends on a sectoral basis; replies to general inquiries on Turkish Legislation either using its own information sources or directing requests to related organizations; supplies information on SMEs worldwide, especially including company profiles which are made available on compact discs for Asia and Pacific countries; European countries in general; Eastern & Central European countries; North and South American countries or through on-line access to the following databases of databanks; EU Legislation, EU Statistics, (from Eurobases); Company profiles (from Knight Ridder)

Using the BC-NET and BRE Networks, which cover, about 75 countries, the SMIDO EICC exchanges company cooperation profiles with her foreign counterparts. In this task, SMIDO also benefits from the information network of DG XXIII of the EU (namely VANS; covering all BC-Net, BRE and EIC members for both information services and business cooperation services). Company matching services using the "Nationwide Business Cooperation Program" developed by SMIDO EICC are carried out at the national level as well. The SMIDO EICC has established a "Local Business Consultants System" through out Turkey, which enables access to more SMEs. Local Business Consultants are composed of the SMIDO Services Centers, various banks, unions, associations (representing specific sectors such as textiles), foundations and several private firms specialized in different areas (quality, foreign trade, legislation, investment business consultancy, etc.) Each of these intermediaries constitutes a node over the subnetwork of the SMIDO EICC, which has been established using the Internet infrastructure.

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