Samuel Neaman Institute

FOR ADVANCED STUDIES IN SCIENCE AND TECHNOLOGY

The Israeli Innovation System: an overview of national policy and cultural aspects

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Technion - Israel Institute of Technology

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Organization

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Knowledge and innovation are key factors for competitiveness and growth in the modern economy. Therefore, policies seeking to create an environment conducive to the generation and diffusion of innovation are increasingly taking a central role in national and international policy debates.

The goal of this review, prepared by an S. Neaman Institute team, is to provide an overview of the national policies and cultural aspects that support and lead Israeli innovation.

The first part of the document includes a review of the Israeli innovation policy. The presentation covers topics such as the process of setting objectives in innovation, policy instruments used in targeting innovation-based competitiveness, implementation of innovation policies, and the evaluation of the policies' effect. This part was compiled in the context of work carried out by the UNECE Team of Specialists on Innovation and Competitiveness Policies (TOS-ICP), which is part of the UNECE Subprogram on Economic Cooperation and Integration. It draws on policy documents, reports and other materials written on the subject, so as to present a comprehensive and general picture of the Israeli innovation system.

The second part of the document addresses several of Israel's cultural aspects that encourage and support innovation and entrepreneurship. Emphasis has been placed on several components that are unique to Israel: the population's cultural fabric, military service in a technological and progressive army, immigration to Israel, and the availability of resources/funding for innovation purposes.

Part 1: The Israeli innovation policy

1. Setting objectives in innovation and competitiveness policies

1.1 Basic conditions for the success of innovation and competitiveness policies

Innovation and technology are systemic and economic (entrepreneurial) processes (Fagerberg, 2005). Innovation emerges from a continuous interaction between firms, their suppliers and buyers, and external actors like universities or research and development (R&D) organizations. Firms are not isolated in their innovation activities but rather perform them in networks; these activities are highly dependent on the external environment at the sectoral, regional, and national levels. The term "national innovation system" (NIS) characterizes the systemic interdependencies within a given country, which influence the processes of generation and diffusion of innovation in that economy. The extensive ongoing research into the driving forces of the interrelated processes of innovation, competitiveness, and economic growth increasingly points to the key role of institutions (UN, 2007).

The Office of the Chief Scientist (OCS) at the Ministry of Industry, Trade and Labor (MOIT), which is the main government body in charge of innovation policy in Israel, is responsible for carrying out government policy concerning support for industrial R&D. Firms submit proposals for R&D projects, which the OCS reviews according to a set of criteria that include technological and commercial feasibility, merit and risks, and estimation of the extent to which these projects can be expected to generate spillovers. The Law for the Promotion of Industrial Research and Development of 1984 is the principal mechanism for providing government assistance for high-tech industrial development. The purpose of the Law is to enhance the development of local science-based industry by utilizing and expanding existing technological and academic infrastructure and by increasing the manufacture and export of high-tech products developed within Israel and thereby improve Israel's balance of trade. The Law determines the conditions for grants, loans, exemptions, discounts, and extenuations on the basis of approved programs in order to fulfill the goals mentioned above. It has been revised several times; most recently in 2005 in order to allow companies to request OCS permission and support for the transfer of know-how developed abroad (MOIT OCS Web site, 2007).

The Israeli economy is based on industry, particularly the high-tech industry. The business sector is characterized by: very strong links with capital markets, mainly in the US, developed over 30 years; a wide range of taxation and customs treaties; multiple types of agreements with the EU, including for trade and R&D; and strong relationships with key Asian countries. Developments in the Israeli economy were particularly positive in 2006, when continued growth worldwide (predominantly in the high-tech industries), a relatively low number of terror attacks, and macroeconomic policies provided favorable background conditions for economic

growth. For many years, Israel has also maintained high per capita spending on national R&D. From 2000 to 2004, Israel was first in the world in civilian R&D spending as a proportion of its gross domestic product (GDP), with an overall investment of 4.6%. The trends of rapid growth and falling unemployment rates have continued now for more than three years. Unemployment fell to its lowest this decade and reached 7.7%. The main reason for the expansion of employment in the various industries was the acceleration of economic activity. The growth rate of manufacturing output accelerated, mainly due to an upturn in exports. In the past three years, manufacturing industry exports have been powered by high-tech and innovative products, which are human-capital intensive (Rosenbaum et al., 2007; Bank of Israel Report, 2006; Central Bureau of Statistics, 2006).

Table 1: Israel high-tech cluster – Selected structural elements (1970s-1990s)
(Teubal et al., 2005)

	1970s	**1980s**	**1990s**
Number of start-ups (SUs) created	~150	~300	~2,500
Funds raised by VCs (in m. Euro)	0	~40	~6,850
Capital invested in Israeli SUs by VCs (incl. foreign) (in m Euro)	0	~40	~5,362
Total number of IPOs (high-tech):	1	9	126
Total number of VC-backed IPOs	0	3	72
Total number of significant mergers and acquisitions by MNEs:	0	0	~75
Capital raised on NASDAQ in the decade (in m Euro)	~8	~40	~8,670
Mergers and acquisitions (in b Euro)	~0	~0	~14,680
Number of international investment banks in Israel	0	1	
Number of VC companies	0	2	~100
ICT exports' share of manufacturing exports	~14%	28%	54%
ICT manufacturing exports (in m Euro)	280	1975	10,440
Software exports (in m Euro)	0	60	2,100
Civilian R&D as percentage of GDP	1.8%	2.8%	4.8%
ICT employees (thousands)	~60	~80	152
ICT skilled employees (thousands)	~26	37	57
Patents issued	140	325	969

The strong legacy of R&D investment began, and continues today, with Israel's requirements for defense R&D spending. The defense-related infrastructure is acknowledged as the crucible from which Israel's competitive high-tech industries emerged. Fields such as security, telecommunications, computing, electronics, optical engineering, and also aspects of semiconductor manufacturing, were fashioned in the service of Israel's defense industry. Especially during the 1990s, as defense research on these technologies matured and high-tech business opportunities multiplied, Israel's practical need for new sources of revenue fostered their transfer to applications in the private sector. Even today, the link between Israeli defense and high-tech communities continues to produce outstanding economic results.

The Israeli government's support for R&D was meant not only to incentivize innovative activities, but also to compensate for the lack of well-developed capital markets. With few exceptions, the high-tech sector could not rely on local sources of

finance and, for the most part, could not raise capital abroad either. Thus, the R&D subsidies provided by the OCS fulfilled an acute financial need but could hardly compensate for the dearth of other financial sources.

The development of an innovative and highly successful information and communication technology (ICT) sector in Israel exemplifies both the potential and the limitations of a high-tech strategy as a lever for economic growth. By the early 1970s, after two decades of extraordinarily rapid growth, the Israeli economy had reached an impasse. Israel has few natural resources, but plenty of highly skilled manpower and scientific and technological prowess; hence, the question was how to mobilize these assets for economic growth. The Israeli government then made a crucial strategic decision to develop a "science-based" sector, by providing broad financial support for commercial R&D and compensating for market failures (Trajtenberg, 2005).

1.2 Identification of policy priorities and foresight

A country's ability to improve coordination between different policies to achieve long-term objectives becomes paramount to long-term competitiveness and growth. In order to be successful, the setting of priorities should be embedded in a broader process of innovation and science and technology (S&T) policy formation, using an inventory of strategic intelligence tools like foresight, benchmarking, monitoring, evaluation, and assessment. In their absence, coordination may take place with lower level activities and consultations (OECD, 2005).

Israel does not pursue an explicit innovation policy; nor are there specific measures for encouraging innovation as a tool for achieving objectives. Innovation is encouraged as a by-product of R&D-encouragement programs. In these programs, innovation is a paramount criterion, but the objective is to encourage R&D that will lead to manufacture, employment, and export. It is presumed that without an innovative edge, the chance for market success would be much lower. For many years, the Israeli government's policy in this realm was "neutrality", meaning that the government did not isolate sectors, firms, or technologies to support, but rather responded to market demands and signals. This proved to be a crucial feature that undoubtedly played an important role in ensuring the long-term success of the strategy. Therefore, no specific innovation areas were pinpointed and all technological fields were prioritized equally. The development of strong sectors of biotechnology, nanotechnology, and internal security is, to some degree, a later exception—since R&D projects in biotechnology and nanotechnology take longer to ripen.

The **Yozma** program, launched in the early 1990s, was the first and only targeted program implemented by the OCS. It was designed to create a local VC industry from a very limited starting base, and was outstandingly successful. So much so that, after several years, the newly set-up VC firms completely bought out the government.
The Yozma fund focuses on drawing foreign capital to invest in the Israeli high-tech industry. Yozma's primary goals were:

- Promotion of promising technological initiatives in Israel

- Encouragement of the involvement of major international investment houses in the Israeli technological sector
- Development of a private sector of management that will serve the Israeli venture capital industry
- To act as a flexible partner with international firms that wish to invest in the Israeli high-tech sector

Despite the unequivocal success of Yozma (which was adopted by many countries), the shift to targeting has only just begun in Israel. Yet, this is a major requirement, providing considerable opportunities for the development of innovation in the long term.

The OCS announced its intention to support traditional industries, process R&D (rather than solely product R&D, which has been the most strongly supported type of R&D), and programs related to industrially designed materials. One of the reasons for this development is the growing awareness that the benefits of economic growth must be distributed beyond the confines of the high-tech sectors, which still represent only about 15% of the economy. Attention is increasingly given to the remaining 85% of the economy, which are not related to the high-tech sector. Thus, it is recognized that widespread economic growth depends on innovation in the economy at large. The Israeli innovation policy is also characterized by dynamism: new and varied programs are created in response to changing needs, and existing programs are constantly being fine-tuned in light of market developments (Trajtenberg, 2006).

Since there is no policy of budget allocation to specific sectors, but rather allocation according to request and demand, the allotment of OCS grants reflects the abilities and interests of the Israeli industry. In 2003, for instance, the distribution of the OCS conditional grants was: communications–36.5%; life sciences–22%; software–17.3%; electronics–9.1%; electro-optics–8.1%; chemicals–2.6%; other–4.4%.

In 2004, joint R&D funds were established between the OCS and each of the following entities: IBM, Alcatel, and the states of New York (USA), Maryland (USA), and Victoria (Australia). This is a new development, insofar as previous agreements had been made only with countries, rather than with regional entities or organizations (Teubal et al., 2005). The Israeli government is also aware of and attempting to deal with the need to develop links with emerging R&D-performing countries such as India and China, and to implement more selective support programs.

1.3 Comprehensiveness, relevance, and effectiveness of the policy mix

The rationale of innovation policy generally determines the scope of the policy mix and whether the dominant concern will be only the ‘broad’ or also the ‘narrow’ policy mix. The ‘broad’ policy mix addresses the space from macro and business environment policies to the specific innovation policy instruments. The ‘narrow’ policy mix covers the policy instruments within innovation policy proper. These categories can never be clear-cut in practice, due to difficulties in ascribing which policy instruments affect the innovation process and how they do this (UN, 2007).

R&D in Israel has concentrated heavily on information and communication technology (ICT), and on product rather than process innovation, implying that most of the Israeli economy has not been engaged in innovation, even though its high-tech sector is remarkably advanced. Furthermore, the fact that innovations in Israel are, for the most part, aimed at exports, that a significant fraction of the R&D is performed by multinational labs, and that over 40% of start-ups are financed by VCs, means that a great deal of the benefits from these innovations flow to firms and users abroad, rather than to the local economy. There is a disconnect between the fact that Israel spends 4.6% of its GDP on R&D, which, in fact, generates a vast amount of cutting-edge innovations, and the slow-paced growth of the non-high-tech economy. Along the way, the potential benefits of this innovation-based strategy are partly dissipated and fail to reach most of the sectors in the local economy and most of the population (Trajtenberg, 2006).

The trend of privatization and budget cuts is sharply affecting Israel's capacity to undertake new initiatives. Overall, policy debates have focused on the following issues:

- Allocation of the OCS budget in the private sector (given that demand exceeds supply by far)
- Sector prioritization between, for example, stem cell research, nanotechnology, biotechnology, internal security, ICT, etc.
- The need for a private equity fund to support small and medium enterprises (SMEs) in mid/low-tech industries and service centers, and the form this equity fund should take
- A revision of the Israel intellectual property laws relating to pharmaceutical companies

It is widely accepted that public and private entities (R&D stakeholders) must cooperate more-and more efficiently-and that long-term efforts must be launched to address the questions that have been raised and to propose new courses of action. There seems to be a consensus that the time is right for a review of government R&D policy priorities. The debate whether Israel should have a centrally planned research prioritization policy is still ongoing. Field-specific policies are, therefore, poorly developed or nonexistent. Some consensus is beginning to emerge on the topic of prioritization: the MOIT highlights fields that are industry and product oriented, focusing mainly on basic and strategic S&T research, while the academic establishment is reluctant to set any priority other than excellence in academic research. Based on two works ordered by Israel's Forum for National Infrastructures for Research & Development (TELEM)-The Israel National Nanotechnology Initiative[1] and the Monitor Report on Israeli biotechnology industries[2]- the Israeli government has recognized the importance of promoting and supporting the nanotechnology and biotechnology sectors.

[1] The Israel National Nanotechnology Initiative (INNI): http://www.nanoisrael.org/
[2] Monitor Report on Israeli biotechnology industries: http://www.usistf.org/download/documents/Reports-ScienceTechnolgy/Monitor-Report.pdf

1.4 Building systems of incentives for support from key constituencies

The strength of the organizations that form the NIS, the pressure that they exert in favor of innovation and their degree of success in aligning their interests can illustrate the level of innovation policy development in individual countries. Innovation policy differences between countries are generally due to: (a) dissimilar development of 'innovation constituencies'; and (b) varying state activism and attitude. The determination of objectives in innovation and competitiveness policies largely depends on the nature of a country's innovation and competitiveness constituency. In addition, the development and the nature of the policies is not only a reflection of the constituency but also reflects the political economy dynamics of policymaking in the individual country (UN, 2007).

Although Israel is a very small country (only 20,000 sq km), its main economic activities are located in the center of the country. The government operates centrally, but laws or directives are occasionally issued that relate specifically to certain regions or population sectors. The MOST (Ministry of Science and Technology) supports the establishment of an infrastructure for regional research and development applications, which is intended to assist the prosperity and economic growth of peripheral regions. Programs that foster the establishment of research centers include relocation of scientists who will carry out research and raise the scientific research level there.

- The OCS provides R&D support for companies in special geographical areas. Any approved R&D program taking place in a "Development Area" is entitled to a conditional grant of an extra 10% beyond the approved budget. The conditional grant in areas delineated as "Front Line" amounts to an additional 25% beyond the approved budget; an even higher figure is granted to companies that also manufacture in that area.
- In order to attract multinational companies to open subsidiaries or factories in Israel's peripheral areas (in the far north or far south of the country), the government offers attractive packages that include incentives and tax reductions. This has succeeded in attracting dozens of companies to peripheral areas of the country, of which Intel is by far the largest.
- Various local initiatives are aimed at attracting foreign companies to Jerusalem (Israel's capital city) and Beer-Sheba. These initiatives are mostly offered by non-government entities. The government, on its part, has announced various measures to build a scientific infrastructure in Beer-Sheba, e.g., in the area of life sciences, anticipating that this infrastructure will attract foreign companies to set up operations there (Teubal et al., 2005).
- MOST, in collaboration with regional institutions, has established regional R&D centers throughout the country. The regional centers conduct feasible researches that promote Israeli research and at the same time solve regional problems, serving as a link between the peripheries and the center of Israel. The ministry currently operates 12 centers in this framework.
- Technological incubators are government-supported organizations that give fledgling entrepreneurs an opportunity to develop their innovative technological

ideas and set up new commercial businesses. There are 24 technological incubators in Israel today, out of which 15 are located in peripheral areas. One of the incubators was established as a biotech incubator. Approximately 200 projects in various stages of R&D are being hosted by the technological incubators at any given time. By the end of 2006, over 1,000 projects had matured and left the incubators. Of these graduates, 57% have successfully attracted private investments; 41% (since the beginning of the program in 1991) are still up and running.

- The MOST is making a special effort to increase the number of active Israeli Arab, Druze, and Circassian scientific researchers, in order to integrate these minorities into the R&D and innovation activities.
- The MOST has also established a fellowship for PhD-level scientists from the Arab sector.
- One of the regional R&D centers, Joint Galilee, promotes regional issues common to the Druze, Arab, and Jewish populations, such as environmental quality, sanitation, and agriculture.
- The Ministry of Defense has launched a special program to enlist high school graduates from economically weak regions to study in special programs conducted at various technological faculties prior to their army service.

2. Policy instruments targeting innovation-based competitiveness

Innovation-based competitiveness is a multidimensional phenomenon for which knowledge generation is an important but insufficient condition for innovation-based growth. An operational model that allows for grasping the multidimensional nature of innovation at country level and its policy aspects, as well as the possibilities of fully utilizing the existing potential for enhancing competitiveness and growth, is the notion of national innovation capacity (NIC) (Radosevic, 2004). The innovation capacity of an economy depends not only on the supply of R&D but also on the capability to absorb and diffuse technology and on the demand for its generation and utilization. From a policy perspective, innovation capacity also depends on innovation governance; that is, on a set of institutions and rules that affect the innovation process.

Innovation policy is any policy measure and mechanism that affects the innovation process and that uses the concept of NIC as an organizing framework to capture this comprehensiveness of innovation policy. In this section, we analyze the role of innovation governance as a core dimension of national innovation capacity (UN, 2007).

2.1 Policies targeting the absorptive capacity

The absorptive capacity denotes all activities that contribute to the successful absorption and adoption of technologies either new or known to the firm and to the country. Proxies for these capabilities are skills and experience of employees and their educational levels. The main sources of growth in developed market economies are in innovation, knowledge and in the capacity to integrate ICT into business and social processes, and these will increasingly be based on a developed university system (UN, 2007).

The successful landscape of advanced R&D and high-tech industry in Israel can be attributed to the country's demanding and resilient emphasis on technical education combined with its nonstop investment in new technologies. Israel's workforce is among the highest educated in the world—about 55% of Israel's working population have 16+ years of education. Technical and scientific education is as deeply valued by Israeli society as is education in the humanities and arts.

Israel suffers from a "brain drain" (i.e., the flight of qualified scientists and engineers abroad in search of better opportunities, income, or benefits).[3]

Israel boasts 8 universities and 27 other academic institutes. Foremost are 6 vibrant, world-class academic and scientific research campuses, each with its own specializations, history, and learning traditions. Of these 6 campuses, 4 are located within less than one hour's drive from one another.[4] This close proximity naturally simplifies academic interplay and promotes crossover research, providing a good basis for Israel's reputation as a center for multidisciplinary research. Additionally, upon graduation, many students are well acquainted with contemporaries and past advisors who are already employed in their field. The natural result is that the transition from learning to working environments is more fluid, professional advancement is easier, and as professional careers progress, the proximity factor influences knowledge sharing, promotions, team building and even product design.

Acceptance to a university is not trivial in Israel; even candidates for minor degrees must prepare for and pass qualification tests, which also require proof of English language comprehension. The THES World University Rankings (The Times Higher Education Supplement, 2006) ranked three Israeli universities among the 200 world leading universities. Yet, Frenkel & Leck (2003) found that there is a significant decline in the official governmental position compared with other developed countries, mainly in terms of investments in students and in the ability to attract them to scientific and technological studies. It is notable, however, that a

[3] Israelis travel abroad to study for advanced degrees, to seek more lucrative work opportunities, or to begin new start-up companies. Unlike their counterparts, many of these individuals in fact return to Israel for a variety of personal, professional, or patriotic reasons. The Israeli government provides special incentives to returning scientists and engineers, and so Israel often benefits from the additional or applied knowledge acquired abroad by those who return (about 50%).

[4] The Hebrew University of Jerusalem, Tel Aviv University, Bar-Ilan University, and the Weizmann Institute of Science are all located in the country's highly populated central region and are mutually accessible via private and public transportation, generally within 30-60 minutes. The Technion—Israel Institute of Technology is located in Haifa, about 90 kilometers north of the central region, and the Ben-Gurion University of the Negev is located in Beer-Sheba, about 100 kilometers south of the central region.

government-supported Open University operates in Israel and provides an opportunity for anyone interested in lifelong learning. The curriculum resembles that of other universities, and no special emphasis is placed on technological training (Cohen, 2004).

The high demand for academic education resulted in recent years in the establishment of colleges, recognized by the Council for Higher Education, which gives them the right to grant academic (bachelor's) degrees.

In the knowledge-driven economy, lifelong learning is critical for innovation. As such, lifelong learning is a typical multi-stakeholder issue influenced by a large number of different, but inter-linked policies.

Programs of continuing education and external studies are offered by every university. These study programs are developed for science and engineering graduates and for senior professional employees in the engineering and management sectors, aiming to enhance the knowledge base of the scientific and technological workforce.

The IDF also operates programs in response to the high technological demands of the modern military force:

1) The IDF academic program ("Atuda") enables soldiers to postpone military service until after graduation. Candidates for the program must be approved by the military authorities.
2) The "Talpiot" program trains a selected few in science and technology while in service. This group of especially talented and motivated people undergoes tailor-made university training in parallel with military training. Focus is placed on the R&D needs of the IDF and on training future R&D leadership.
3) Another program provides privileged financial conditions for pre-service engineering students whose education is directed towards R&D. The framework is civilian; the military service after graduation is prolonged.
4) Another initiative, launched by the Ministry of Defense in 2001, focuses on the recruitment of able high school graduates from weak peripheral regions to a special academic technological studies program prior to their military service.

Various government ministries also run different programs aimed at developing human capital for the industry.

One of these is a program operated by the Finance Administration of the MOIT aimed at guidance for very small, small, and medium-sized businesses. The program provides assistance in the application of business management tools in order to improve performance and profits. To this end, a large database of guides has been established. It contains hundreds of experienced consultants with expertise in a wide variety of fields, such as general management, financial management, production management, marketing management, information systems, and human resources management. The number of consultation hours granted to each firm is determined according to the number of its employees (Cohen, 2003).

The objective of the MOIT assistance program is to increase the availability of human capital in Israel so as to further industrial development, to internalize an

enduring culture of development among factory employees in development areas as an integral part of their daily routine, and to expand the pool of human capital required for the knowledge-intensive and high-tech industries in Israel as a whole.

The program assists industry through three separate tracks: Track 1 offers direct assistance to factories in development areas; Track 2 supports special projects for the development of human capital in cooperation with educational and other institutions; and Track 3 supports the development of human capital for knowledge intensive and high-tech industries throughout the country.

Another program is provided by the Ministry of Social Affairs and Social Services, which offers retraining courses for IDF veterans/newly released soldiers, unemployed, new immigrants, and ultra-Orthodox citizens (mainly women). These courses are, to some extent, technologically oriented (Hemar & Refuah, 2002).

2.2 Policies targeting the generation of knowledge

Knowledge generation involves a large set of activities that go beyond R&D. Incremental improvements in products and production techniques, software, design, and marketing, as well as active use of new knowledge and new technologies developed elsewhere, should all be considered as knowledge-generating activities (UN, 2007).

Innovation in Israel is extensively financed by the government, both directly and indirectly. Direct financing is administered mainly through the implementation of the Law for Encouragement of Industrial Research and Development, the technological incubators program, and the MAGNET program. Funding rates vary between 30% and 85% of approved budgets for salaries, materials, and subcontractors, and are subject to limitations and ceilings according to the specific programs and to repayment of royalties. Changes in financing rates are contemplated in order to achieve more flexibility in grant allocation. R&D projects supported by the OCS within the framework of the above-mentioned law are entitled to funding of their patenting expenses.

A government seed fund—the Heznek Fund—was launched in 2002 to share investors' risk in new start-up companies. The program emits a positive signal to investors and creates further incentives for mobilizing investments for the establishment of start-up companies. The program is based on the government matching any investment made in a start-up company and on giving the investor a two-year option to purchase the government's shares in the start-up company at the initial price.

Indirect financing is administered by giving tax concessions to organizations and companies that actively support innovation-oriented activities. Such organizations include MATIMOP, the Israeli industry R&D center; Inbal, a government fund established to support research and development funds by purchasing 80% of the shares from any investor wishing to sell; the Investment Promotion Center, which runs a variety of programs aiming to encourage industries and businesses to achieve

the goals of growth, sales, export increase, profitability increase, and additional employment; and the Yozma fund that focuses on attracting foreign capital for investment in the Israeli high-tech industry (Cohen, 2003).

The venture capital (VC) industry in Israel is highly developed. Israel hosts over 100 active funds, collectively managing over $12 billion. The year 2006 was a year of impressive fund gains, as well as numerous successful exits for VC firms doing business in Israel. The most recent growth trend began in mid-2003 and covers a broad range of Israeli high-tech industries. The first half of 2006 showed a capital investment of $764 million, up 4% over the same period in 2005. Israel also remains an attractive target for commercial investment by foreign companies. In the first half of 2006, more than 50 Israeli firms were the subject of mergers or acquisitions, with investments of over $12 billion.[5] Foreign investment and M&A activity are expected to expand in 2008, when Israel formally adopts the International Financing Reporting Standards used by many nations to globalize financial statements for public companies. Israel also has the third largest concentration of start-up companies in the world, preceded only by Silicon Valley and the Boston area. Some 3,000 Israeli technology start-ups are currently marketing their products in the US alone. Figures routinely released by Israel's Central Bureau of Statistics show that high-tech exports comprise nearly 75% of all export sales.

2.3 Policies targeting the diffusion of innovation

The importance and variety of related linkages enable innovation to evolve as a systemic activity, implying an important role in the process of diffusion of innovation. Facilitating the diffusion of new knowledge through the economy thus calls for policies focused on different forms of partnerships (UN, 2007).

In Israel, intensive large-scale cooperation between researchers from universities and companies is driven through the variety of programs run by the MOIT and the MOST (Getz et al., 2005; MOIT Web site, 2007; Getz & Kahane, 2002, 2003).

2.3.1 The main MOIT programs for implementing long-term national and international R&D and innovation

1) MOIT programs aiming to support starting entrepreneurs:

Tnufa- A promotion program designed to give momentum to promising and determined entrepreneurs in developing start-up companies. The program intends to enable entrepreneurs to conduct preliminary feasibility studies for their ideas, and to help them file patents, build prototypes, and prepare business plans. Grants amount to up to 80% of the approved budget, with a maximum of €25,000, or €50,000 for an

[5] Press Release, Israel Venture Capital Research Center, *Capital Raised by Israeli High-Tech Companies in Q2 2006 Reaches $404 Million—Up 12% from Q1*, July 17, 2006. Available at http://ivc-online.com/upload/archive/survey/Q2-06.pdf

outstanding project. Tnufa provides business and marketing consultation as well as assistance in locating potential investors (Hemar & Refuah, 2002).

Technological Incubators- Government-support organizations that give fledgling entrepreneurs an opportunity to develop their innovative technological ideas and set up new businesses in order to commercialize them. The program nurtures novice entrepreneurs at the earliest stage of technological innovation, helping them to implement their ideas, turn them into exportable commercial products, and form productive business ventures in Israel. By absorbing a large portion of the risk inherent in this early stage, in which commercial funds play a minor role, the technological incubators provide entrepreneurs with physical premises, financial resources, tools and equipment, professional guidance (management and business expertise), and administrative assistance, so that during their stay in the incubator, they can turn their abstract ideas into products with proven feasibility, novelty, and advantages sought in the international marketplace. An entrepreneur's term of activity in a technological incubator considerably enhances prospects of raising necessary financial investments, finding strategic partners, and emerging from the incubator with a viable business.

The three main criteria for acceptance into the program are: (a) that the product must be marketable for export and capable of forming the basis of a business; (b) that the product must be in a high-tech field; and (c) that the product must be manufactured in Israel.

The incubator activity takes place in all fields of R&D. While there are no predetermined fields of specialization for the hi-tech incubators, some have chosen to specialize or partially specialize in areas such as software, life sciences, medical devices, environment, water, IT, and communications. The total budget for an entrepreneur's two-year term ranges between US $350,000 and US $600,000, whereby 85% of the approved budget may be provided as a grant or soft loan. Budgets for biotech incubators may be up to $1,800,000 for three years and 80% of the approved budget may be provided as a soft loan.

At the conclusion of the two-year incubation period, the young company may apply to the OCS for further R&D support and/or beta site testing. Payback is required only in cases of success. There are currently 24 technological incubators in Israel, of which 17 have been privatized and one is a biotech incubator. Approximately 200 projects at various stages of R&D are being carried out in the technological incubators at any given time. By the end of 2006, over 1,000 projects had matured and left the incubators. Of these graduates, 57% have successfully attracted private investments. Of all incubator graduates (since the beginning of the program), 41% are still up and running. By the end of 2006, the total cumulative private investment in incubator graduate companies surpassed $1.5 billion. The program is currently undergoing evaluation by the MOIT (MATIMOP, 2007).

Heznek Fund- The government seed fund targeted at encouraging investments and increasing the number of new companies. MOIT established this new and

separate vehicle to provide a positive signal to investors and create further inducements for mobilizing investments for the establishment of start-up companies. The program is based on the government matching investments in start-up companies and on giving the investors the option of purchasing the government shares in the start-up companies at their initial price.

2) MOIT programs aiming to support Generic R&D:

The MAGNET program, run by the Office of the Chief Scientist of the MOIT, sponsors innovative generic industry-oriented technologies in order to strengthen the country's technological expertise and enhance competitiveness. MAGNET activities are based on collaboration between companies and academic research groups organized in consortia of several members or as a dual cooperation between one academic group and one industrial company, depending on the chosen track.

The common denominator of collaboration is a win-win proposition. Both industrial companies and academic research groups are better able to continue developing new and innovative products through synergetic collaboration than if each worked alone.

MAGNET's main goal is to allow each company to develop technologies in addition to all its other activities. The program by definition is high risk and the ROI is obtained only after an extended period of time. Therefore, the grant rate to an industrial company is up to 66% of the total recognized expenses and no royalties are expected to be paid back. Academy partners are granted 66%, 80%, or 90%, according to the chosen track, with the balance borne by the industrial companies.

The MAGNET program is comprised of four main tracks:

1) Consortium—generic technology R&D
2) Association—distribution and implementation
3) Magneton—technology transfer
4) Nofar—basic and applied research

Consortium: Based on technology unionizing, teams of industry developers and academy researchers work cooperatively to develop the basic innovative technologies that the next generation of their product lines may require. The program period is three to six years. At the end of each year, the new ideas and concepts are simultaneously examined—specifically those that can be realized within a few months—in order to approve the most promising ideas according to MAGNET priorities.

Magneton: This track provides for dual cooperation between academic group and industrial company. The purpose is to foster technology transfer with the goal of increasing the feasibility of a technology resulting from academic research, prior to implementation by the company for further development. The duration of the program is up to two years and grants a budget of up to $800K.

Association: Because many existing technologies do not require redevelopment, members of the same industrial sector organized as a "users' association" can benefit from the latest know-how by implementing and integrating it into their own activities. The program schedule is ongoing. Each group is examined separately to evaluate the

extent to which it can participate in the MAGNET program.

Nofar: This is a purely academic research program for basic and applied research. The goal is for research to attain a milestone that will enable an industrial company to access sufficient information for investing in and proceeding with R&D. Participation in the program requires a 12-month commitment and is granted a budget of up to $100K, constituting 90% of the budget. An assisting company must pay the 10% balance.

The **Israeli Industry Center for R&D (MATIMOP)** is a public non-profit organization founded by the three major associations of manufactures in Israel. MATIMOP functions as the interface between Israeli companies and their international counterparts to promote joint development of advanced technologies. It encourages participation in many international programs for bilateral and multilateral cooperation in industrial R&D. The international R&D activities include participation in the European RTD framework program, EUREKA, and binational R&D-oriented agreements coordinated on behalf of the OCS by MATIMOP. The center also manages a group of binational R&D funds and runs an encouragement program aimed at creating R&D cooperation between Israeli research entities and multinational companies (MNCs).

The **Global Enterprise R&D Cooperation Framework** was established by the OCS in order to encourage industrial R&D cooperation between Israeli and multinational companies (MNCs). The Global Enterprise R&D Cooperation Framework provides a range of significant incentives, through which the OCS shares the high risks and costs inherent in high-tech development with the partnering companies. Each cooperation model is tailored to the MNC's specific needs and requirements[6].

2.3.2 The main MOST programs for implementing long-term national and international R&D and innovation

In 1995, the MOST initiated the establishment of the **Scientific and Technological Infrastructure Development Program**. The program is aimed at harnessing the professional manpower and economic potential that can be derived from Israeli science. The program mediates between the academic basic research and the applicative development.. In addition, the program provides for the training and nurturing of the elite professional workforces required for the chosen prioritized fields.

The Scientific and Technological Infrastructure Development Program was implemented by six national Committees for Technological and Scientific Infrastructure Development, covering six fields in which Israel holds a world-class position: electro-optics, biotechnology, advanced materials, information and

[6] More information about the Global Enterprise R&D Cooperation Framework can be found at: http://www.israeltrade.gov.il/NR/rdonlyres/BC098504-214C-478A-96A3-2B23DB73322E/0/Global_Enterprise_R_D_Cooperation.doc

teleprocessing, micro-electronics, and water and environmental research. Graduates of the program eventually become the leading force in the Israeli high-tech industry[7].
MOST, in collaboration with regional institutions, has established **regional R&D centers** throughout Israel. These centers conduct feasible researches that promote Israeli research and solve regional problems at the same time. The centers serve as a link between the periphery and the center of Israel. In order to realize the full scientific, social, and economical potential found in the periphery, regional R&D centers are anchored by leading researchers who maintain personal involvement and interest in the region and who are involved in all aspects of the center[8].

The **BASHAN program** is a unique Israeli government organization for the encouragement and promotion of technological entrepreneurship, novel technologies, and innovative products, as well as the realization of technological and scientific potential of new immigrants in Israel. BASHAN offers its services free of charge to new immigrants from all over the world, returning residents, and potential (future) immigrants.

The goals of BAHSAN's activity are:

- To promote technological and scientific inventions and ideas of new immigrants in Israel (individuals and start-up companies)
- To assist immigrant scientists and engineers in their absorption and integration into the Israeli industry
- To guide and advise technological entrepreneurs and scientists who are still abroad and who are considering immigrating to Israel
- To develop technological and scientific cooperation with the countries of Eastern Europe and the CIS (former Soviet Union) through the promotion of technological enterprises[9].

2.3.3 MOST—Internationalization of technology R&D programs

Today, no country can rely on knowledge created within its borders. Internationalization of technology is no longer confined to knowledge utilization but also includes knowledge generation. R&D internationalization is no longer driven by adaptation to local conditions but by a variety of new push-and-pull factors and involves complex stages of R&D (UNCTAD, 2006).

[7] More information about the Scientific and Technological Infrastructure Development Program can be found at the MOST Web site: http://www.most.gov.il/English/Units/Science/Infrastructure+Programs/Research+and+Scientific+Programs/Forming+a+Scientific+Oriented+Policy.htm).

[8] More information about the Regional R&D centers can be found at: http://eracareers.most.gov.il/Science+and+Technology+in+Israel/Regional+Research++Development+Centers/

[9] More information about the Bashan program can be found at: http://www.most.gov.il/English/Units/Science/Programs/BASHAN+Program/default.htm

International science relations embraces "export" and "import" of knowledge, the implementation of which leads to acknowledgment of the State of Israel as a scientific powerhouse worldwide. In order to realize the "export of science" goal, there is a need to instate Israeli diplomatic delegates around the world who will serve as "science counselors". A number of destinations have already been selected for diplomatic science relations with Israel, according to definite criteria: the former Soviet Union, the countries of the Pacific Belt (Southeast Asia; with special emphasis on Singapore and Japan), and the countries of Central and Eastern Europe**.**

The **Researchers Exchange** program is aimed at creating a network of scientists for the benefit of science promotion. This included funding air travel tickets and living expenses for the 22 Israeli researchers who visit different research institutions in order to promote international cooperation in common research areas.

Israel is a member in several **international organizations** and an affiliated member in many more organizations (such as the European Union—the 6th Framework Program, OECD, UNESCO, and ESRF). Past experience shows that Israel was accepted as a full member in scientific organizations when it was one of its founders. Israel's membership in international scientific organizations is not only an expression of recognition of Israel's scientific abilities, but a positive declaration of its political status. MOST invests considerable efforts in order to make Israel an affiliated member in unique international organizations that are indisputably considered world-leading research groups. The ministry attributes great importance to ensuring Israeli scientists' access to major research institutes and the integration of Israeli scientists in major international research cooperation programs. The ministry reviews such activities worldwide and attempts to advance relations with such bodies and groups.

ERA-MORE is a joint initiative of the European Commission and the 33 countries (including Israel) participating in the EU Framework Program for Research. The purpose of this initiative is to create a more favorable environment for researchers' career development[10].

The Israel Space Agency (ISA) The history of Israel in space is short but remarkable. It started in 1988 with the launch of Ofeq 1 by the Shavit launcher, affiliating Israel with the very exclusive club of seven countries that had launched a self-developed satellite using their own self-made launchers. Geographical constraints and security considerations led the Israeli space program to focus on very small satellites, loaded with highly sophisticated payloads.

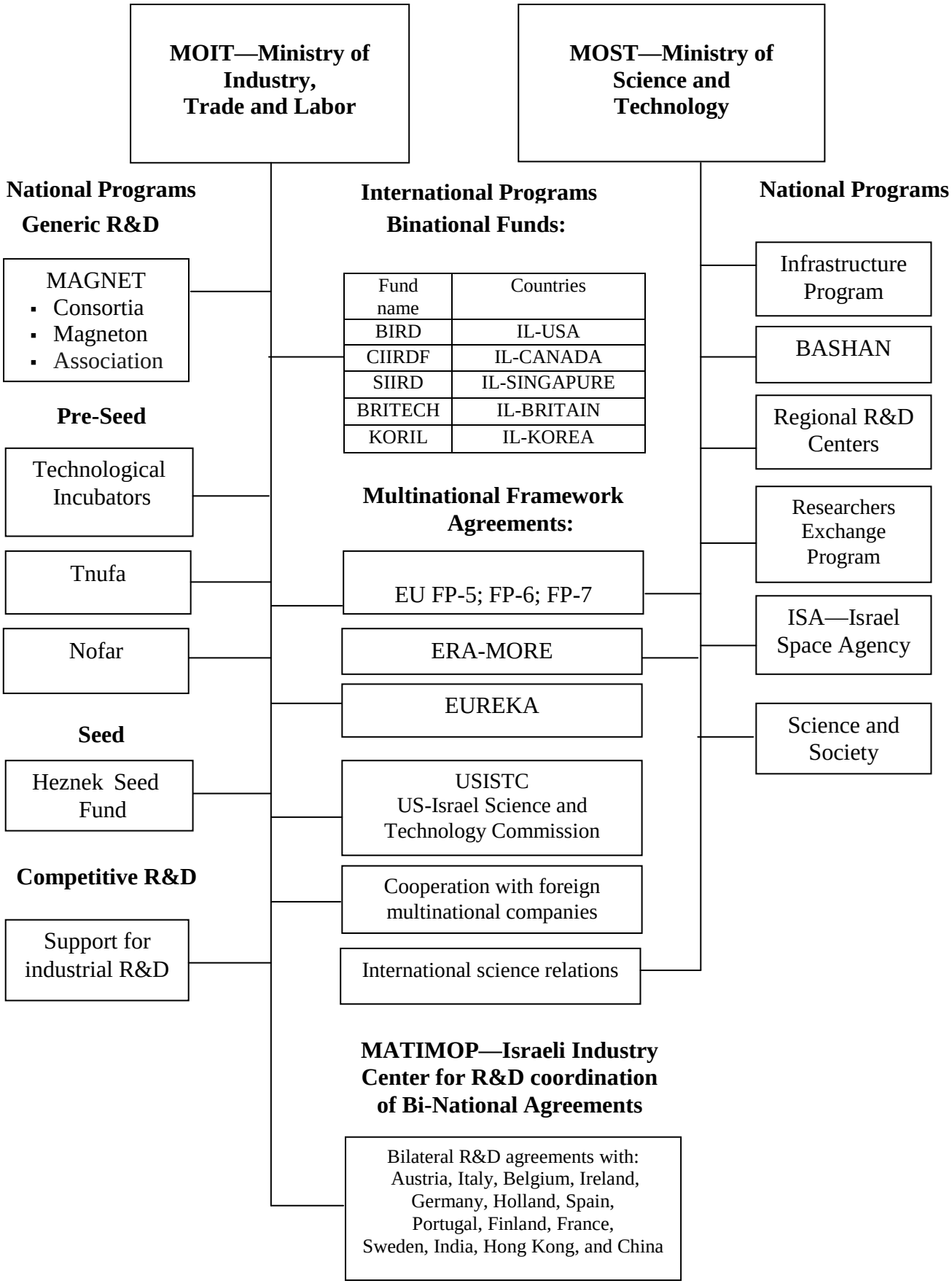
The ISA and the Israeli industry and academia are all involved in different stages of space-related research and in the development, construction, launching, and operating of a series of space-related programs.

[10] Most Web site: http://www.most.gov.il/English/Units/Science/Programs/International+Relations/General+Overview.htm

In order to enable the advancement and execution of work plans and development programs in this field, which strengthen and advance Israel's space-related capabilities, the MOST has initiated, via the ISA, the establishment of new knowledge centers[11].

[11] More information about ISA can be found at Most Web site: http://www.most.gov.il/English/Units/Science/Programs/International+Relations/General+Overview.htm

Figure 1: Highlights of the MOST and the MOIT Support Programs



2.3.4 Raising the awareness of the general public and involving those concerned

Science contributes to the economy, to the cultivation of human resources, and to the diminishing of social gaps. Therefore, MOST endeavors to promote the connection between the community and science, in order to raise public awareness, especially amongst children and youth, to its importance. The ministry program comprises three streams of activity:

- A Science Cadets program, which consists of classes, exhibits, and mobile science labs intended for children and youths located in development towns, low-income neighborhoods in the main cities, and in community settlements. Scientific Enrichment Projects that consist of activities operated by local frameworks (community centers, local authorities, etc.) and which are intended for the general population, with an emphasis on peripheral areas and low-income neighborhoods. The activities include enrichment classes for children and youth, science gardens, mobile science labs, and scientific publications.
- Support for science museum budgetsby means of financing educational projects, traveling exhibits, science fairs, and various scientific activities[12].

2.3.5 Public authorities and non-governmental organizations (NGOs)

Examples of Israeli public authorities and NGOs that support innovation are:

Centers for the Promotion of Entrepreneurship (CPEs): The Israel Small and Medium Enterprises Authority is engaged in establishing and supporting the operation of Small Business Development Centers. The authority operates in this area in cooperation with other entities, including government ministries., the Jewish Agency, local authorities, the Joint Distribution Committee, and various business organizations. Each center functions as "a one-stop shop"—a central address for the businessperson or the entrepreneur, in which he or she can receive help through a comprehensive range of services[13].

The Samuel Neaman Institute (SNI): The SNI is an independent, non-profit organization, established in 1978 with the objective of seeking solutions for national problems in the economic, scientific, and social development of the State of Israel. The institute was instrumental in developing the MAGNET program together with the chief scientist, and has been active in the program for over ten years. Through this program, the SNI has acted as bridge between academia and industry to foster joint R&D and technology transfer between the two sectors. The S. Neaman Institute has

[12] Most Web site: http://www.most.gov.il/English/Units/Science/Programs/International+Relations/General+Overview.htm

[13] More information about the Centres for the Promotion of Entrepreneurship (CPEs) can be found at: http://www.asakim.org.il/english.php?pageid=2

established and operates one of the largest information centers in the country on behalf of many of the MAGNET consortia.

2.4 Policies targeting the demand for innovation

Most of the Israeli government ministries have a chief scientist to encourage the commercialization of science and technology in their respective areas of responsibility. The Ministry of Science and Technology aims to develop new technologies that will lead to new-generation products: industrial, agricultural, medical, and environmental products replacing older generation products through guided practical research.

The National Council for Civil Research and Development (MOLMOP) advises the government on civil R&D in terms of short- and long-term national policy, prioritizes R&D areas according to Israel's relative advantages, follows the implementation of R&D policy, reports the findings, and ensures a professional basis in all national R&D actions. There is a strong affiliation between the Israeli defense industry and the high-tech communities; In many cases, Israeli defense R&D requirements are transformed into private sector applications.

Competition policy: A court ruling has been made to the effect that employees are entitled to make use of know-how that they acquired while working for former employers—short of proven infringements of intellectual property rights. Antitrust and antimonopoly laws are strictly enforced and affect all economic areas, including those of innovation and high-tech.

Intellectual property rights: All of Israel's major universities are publicly owned and funded. Although the country does not maintain a cohesive national policy regarding technology protection and transfer, the attitudes and methods that exist today are profoundly influenced by this basic bond to the Israeli government. Israeli universities recognize the conflict of interest that is likely to emerge owing to the collaboration between researchers from academia and those from industry and other commercial enterprises; nevertheless, all universities encourage such collaboration[14] and most of them cherish the academic freedom of faculty members, above any other economic benefit that may ensue. It is for this reason that they protect the faculty's right to publish[15]—with restrictions, including the need to report to and receive clearance from the institution's administration prior to the publication of a new discovery.

In Israel, the Weizmann Institute of Science, Ben-Gurion University of the Negev, and the Hebrew University of Jerusalem do not object to funding of research

[14] This was also mentioned in the recommendations published in a recent report on university-industry relations. See: Israel Acad. of Sci. & Humanities & the Planning & Budgeting Comm. of the Council for High Edu. (Jerusalem), University-Industry Relations 30–33 (2005).

[15] The Israeli universities that impose some restrictions on publications are the Weizmann Institute of Science and Ben-Gurion University of the Negev.

conducted at the university by a commercial enterprise in which a member of the faculty has a personal or an economic interest, subject to pre-approval by university authorities. This lenient attitude exhibited by Israeli institutions derives both from their desire to broaden their financial base and from their assumption that the university's control over such projects will act as a barrier to any possible conflict of interest and/or commitment.

The universities in Israel require their faculty to report to the university authorities on any new discovery or invention. All universities have established Offices of Technology Transfer (OTT) in order to oversee and supervise patent registration and commercialization of new discoveries. Universities require that the inventor continue to assist the OTT in every possible way so as to improve and commercialize the patent. They also request that their inventors keep their discoveries a secret until the discovery is registered as a patent, in order to protect their innovation.

In Israeli universities, inventions derived from public funding are registered as university-owned patents. All of the universities practice a formula whereby royalties received from commercialized patents and new discoveries are distributed proportionally between the institution and the inventor. The most generous university in Israel is Ben-Gurion University, which awards the inventor with 60% of the benefit to be received. The Technion gives the inventor 50% of the benefits, whereas the Hebrew University offers 33%–35% of the expected benefits (Rosenbaum et al., 2007).

Taxation: The Israeli income tax authorities consider expenditure on R&D projects approved by the Chief Scientist as direct deductible expenses rather than as investments. Tax incentives are offered to: (1) any investor in an R&D program who is not a shareholder in the company; (2) any enterprise owner who is doing research for the enterprise’s development; and (3) any scientific employee/worker who works during a sabbatical year, whereby incentives are given proportionately to salary (Hemar & Refuah, 2002).

In 2002, Israel's legislature, the Knesset, approved the tax reform recommendations of a government-appointed committee. The main recommendations were the imposition of a tax on individuals' capital income, the gradual reduction of taxes on labor income, and the narrowing of the differentials between tax on capital income in Israel and abroad. Among other things, these changes reduce the difference between taxation on capital and on labor in Israel (Cohen, 2002).

The Law for the Promotion of Industrial Research and Development of 1984 has been revised several times. The last amendment was legislated in 2005 to allow companies to request OCS permission for the transfer of know-how developed with the support of the OCS abroad (MOIT OCS Web site, 2007). Until this amendment, strict limitation on technology transfer and overseas production was imposed upon recipients of government research and development incentives. Given the widespread use of such incentives, many foreign investors in Israeli technology firms found it difficult to relocate manufacturing operations and proprietary technology outside Israel. Procedures have been put in place to deal with multiple scenarios; royalties are

now to be paid to the OCS and repayments are channeled back into the OCS budget and used to support other projects.

An OECD review of tax incentives concludes that the effectiveness of fiscal incentives for R&D depends very much on the design of tax measures relative to policy objectives (OECD, 2004). In principle, fiscal incentives should target R&D activities, and not support specific enterprise sectors or groups.

3. Policy implementation and evaluation

3.1 Innovation governance

The governance structure of the national innovation system represents the concerted efforts at many levels in many different organizations, including interfaces with the business sector and society at large, which together generate integrated innovation policy (OECD, 2002).

The importance of innovation governance has increased due to several interrelated factors (Arnold et al., 2003). First, the increasing relevance of S&T to economic growth, environmental performance, and public health heightens the need to involve the public at large in the governance of R&D. Second, the continuing spread of the so-called New Public Management provides a more general impetus towards transparency and efficiency in innovation and research policy. Third, the increasingly systemic nature of innovation implies a need to bring together different types of knowledge and knowledge producers, across disciplines and between fundamental and applied work. Innovation governance in Israel can be viewed as a case of good practice in the management of innovation policy.

The civilian R&D system in Israel comprises three components: government R&D, academic R&D, and industrial R&D. Government R&D is managed, budgeted, and directed by the government through the chief scientists of the various government ministries. Israeli academic and industrial R&D are independent of one another in their R&D activities, but both receive some guidance from the government through its budgetary assistance.[16]

According to Gibbons (1999), the contract between university science and society has traditionally been based on the understanding that universities will provide research and teaching in return for public funding and a relatively high degree of institutional autonomy. The contract between industrial R&D and society has been based on an understanding that industry would provide for the appliance of science through the work of its laboratories, and thus carry the discoveries of basic science into product and process innovations. In turn, government science was meant to use research establishments to fill the gap between university science and industrial R&D. The understanding has been that the state has been directly responsible for carrying

[16] The government participates in the academic research budget through the Council for Higher Education.

out research related to national need. Gibbons point out a tendency towards a new social contract that will reflect the increasing complexity of modern society. There are no longer clear demarcation lines between university science and industrial science, between basic research, applied research, and product development, or even between careers in the academic world and in industry. Interrelated processes form a framework both for rethinking science and for understanding any new social contract between society and science. Reliable knowledge can only become socially robust if the process of knowledge production is transparent and participative for society.

The main government bodies in charge of Israel's innovation policy are the Ministries of Industry, Trade and Labor (MOIT); Science and Technology (MOST); Defense; National Infrastructures; Agriculture and Rural Development; and Immigrant Absorption; as well as the National Council for Civil Research and Development (MOLMOP) headed by the MOST, and the Council of Higher Education headed by the Minister of Education.

Among other things, innovation governance sets directions and criteria for R&D funding. It also ensures horizontal and vertical coordination and aims to improve the profile of R&D and innovation based on policy analysis.

The role of the **Office of the Chief Scientist (OCS)** at the Ministry of Industry, Trade and Labor (MOIT) is to assist in the development of new technologies in Israel, as a means of fostering the Israeli economy, encouraging technological entrepreneurship, leveraging Israeli science-skilled resources, supporting high added value R&D, enhancing the knowledge base of Israeli high-tech industries, and promoting cooperation in R&D, both nationally and internationally.

The Ministry of Science and Technology (MOST) is responsible for forming a national policy that forwards S&T, technological analysis, and organization and coordination of research areas. The MOST emphasizes the importance of infrastructure research; therefore, it supports scientific researches with feasible and economic potential.

Innovation is an inter-sectoral activity with numerous direct and indirect effects and linkages. The potential technology spillovers from one sector to another—as well as the interactions between technology developers, their 'suppliers', and their 'customers'—represent a complex web of interactions whose complexity can only be partly grasped, let alone managed. However, good innovation governance aims to ensure at least some basic vertical and horizontal policy coordination of major innovation actors (EU, 2007).

In Israel, policy coordination is institutionalized through the **Israeli Chief Scientists Forum**. All government ministry chief scientists are members of this forum**,** headed by the Minister of Science and Technology. The Chief Scientists Forum coordinates between the various ministries in order to avoid inefficiency and duplication. The Chief Scientists Forum status is defined by law- the National Council

for Civil Research and Development (MOLMOP) Law[17].

The objective of MOST's **Scientific and Technological Infrastructure Development Program** is to utilize the existing potential within universities to the fullest, in order to develop knowledge fields that have an added value for Israel and that hold future economic potential.

The **Ministry of Defense** exercises an immense influence on the innovation environment through its direct defense-related projects, but probably even more by being the first employer for the majority of the high-tech oriented workforce during their formation years of army service, which is mandatory in Israel.

The **Ministry of National Infrastructures** is responsible for a broad range of issues in the fields of energy, water, electricity, fuel, and soil. The Ministry supervises the Israeli energy sector, including licensing and R&D activities, as well ensuring the effective use of natural resources for the benefit of all citizens and in the light of environmental protection.

The **Ministry of Agriculture and Rural Development** engages in R&D through the Agriculture Research Organization, which is responsible for planning, organizing, and implementing the greater part of Israel's agriculture research effort.

The **Ministry of Immigrant Absorption** is an important player on the innovation scene through its role in the professional absorption of the extremely science- and technology-oriented immigrant population that has been arriving in Israel since the early 1990s. This immigration accounts for almost 20% of the country's total population and about half of the technological workforce.

The **Council for Higher Education** is the state institution in Israel responsible for higher education, including teaching and research. The Council is headed by the Minister of Education and is a recognized statutory body for all matters pertaining to obligations, rights, and legal action. The Planning and Budgeting Committee (PBC) is the Council's executive arm and was established by a government decision. The PBC has exclusive authority for disbursing the global authorized budgets to the various institutions of higher education.

3.2 Implementation of innovation and competitiveness policies

The effectiveness of innovation policy depends on its overall design as well as on the way policy instruments are combined into policy mixes that offer complementary and mutually reinforcing support for national innovation systems (EU, 2007).

[17] More information about the Chief scientists forum can be found at MOST Web site: http://www.most.gov.il/English/Units/Science/Programs/Chief+Scientists+Forum.htm

The OCS at each ministry is responsible for implementing technological R&D programs, both on domestic and international levels (The responsibilities of the different ministries' OCSs and the ministries' implementation programs are specified in detail in sections 2.3 and 3.1 above).

As mentioned earlier, all Israeli universities have established Offices of Technology Transfer (OTT) in order to oversee and supervise patent registration and commercialization of new discoveries. The OTTs assist and support inventors and researchers in protecting their IP rights, commercializing the IP, and forming optimal alliances among scientists, industry, and investors. Towards enabling the transfer of technologies to the business community, the OTTs play an active role in negotiating with strategic partners, licensees, and investors.
The OTTs' areas of responsibility are:

- Analysis of new inventions
- Filing patent applications; protecting and maintaining IP rights
- Negotiating and approving the IP and business aspects of agreements with industry and joint industrial-academic projects financed by companies and/or by the Chief Scientist at the Ministry of Industry and Trade
- Licensing of IP

3.3 Assessment of policy effectiveness

Innovation and competitiveness policies are context dependent and it is difficult to draw any definite conclusions regarding the appropriateness of particular institutional solutions and implementation mechanisms and structures in individual countries. It is important to get a realistic understanding of how far innovation policy can go and what can reasonably be expected of it. Overall, the empirical evidence regarding the effectiveness of different instruments, mechanisms, and institutional structures of innovation policy is quite mixed and does not provide straightforward policy clues (EU, 2007).

Generally speaking, policy making and evaluation practices in Israel are fairly unsystematic, lacking a clear methodology. Notwithstanding, it is well known that Israel is one of three countries (together with Finland and Korea) in which government policy has been very successful in catalyzing the establishment of world-class high-tech industries. Innovation-specific indicators are measured using a comparative analysis of patents granted to Israeli inventors in the US. Since the US patent office is the major target of patentees worldwide, it presents good comparative data for export-oriented R&D. The main trends in Israeli patenting are examined compared with three groups of countries: the G7, a group of countries with GDP per capita similar to that of Israel (Finland, Spain, Ireland, and New Zealand), and the Asian Tigers (Taiwan, South Korea, Hong Kong, and Singapore). Several Israeli programs have been evaluated, including the MAGNET pre-competitive R&D consortia and the Technological Incubator program.

In Table 2, Teubal et al. (2005) present policy-making and evaluation practices. Policy benchmarking and transnational learning are presented in Table 3.

Table 2: Policy-making and evaluation practices (Teubal et al., 2005)

Policy-Making/Evaluation Tool	Criteria	Ranking
Strategic policy making (national strategies, white papers, etc.): prevalence of evidence-based and open consultation procedures	* Almost no background discussions, studies, or stakeholder participation. ** At least some attempt to systematically pursue these activities. *** All of the above items are systematically taken into consideration.	**
Existence of coordination mechanisms (high-level council, interministerial committees, etc.)	* No mechanisms for coordination. ** Few, rather fragmented and bilateral coordination processes. *** Well-organized coherent system of policy coordination.	**
Systematic review process for innovation policy	* Almost no policy documents and hence little assessment. ** A few ad hoc reviews. *** Systematic policy review .	**
Design and implementation of innovation policy measures	* A very centralized/closed system for designing and implementing policy. ** Consultation and partnerships exist mainly on an ad hoc basis. *** Systematic interaction with all stakeholders	**
Existence of an evaluation culture in field of innovation policy	* Rare evaluation of innovation measures—monitoring or auditing only. ** Evaluations of measures are carried out on an ad hoc basis at the request of specific departments or funding bodies. *** Measures are systematically evaluated at key milestones in their implementation.	*
External versus internal evaluations of innovation policy measures	* Evaluations are carried out internally as a general rule. ** A share of evaluations is contracted out to independent contractors, but this is not a generalized practice. *** Evaluations respect good practice criteria (systematically involve external experts, evidence-based, high-quality appraisal of evaluation reports, etc.).	**
Transparency and publication of evaluation results	* Little or no transparency concerning results of measures. ** Evaluations and appraisals are occasionally published or debated. *** All evaluations are published or discussed in a public forum.	**

Table 3: Policy benchmarking and transnational learning (Teubal et al., 2005)

Tool for policy learning	Criteria	Ranking
Formal mechanisms for policy learning (studies, innovation observatories, study visits, etc.)	* No mechanisms exist ** Ad hoc mechanisms *** Very systematic efforts	**
Application of foreign experience in designing measures (e.g., involvement of foreign experts in design phase)	* Not at all or very occasionally ** Occasionally or on an ad hoc basis *** Systematically	**
Exchange or hire of innovation policy staff/experts to/from other countries	* No ** Ad hoc *** Systematic schemes	*
Involvement of senior policy makers/executives in transnational networks (e.g., TAFTIE)	* No ** Yes, in one network *** Yes, in all networks	***
Carrying out benchmarking exercises to assess comparative innovation performance (scoreboards, etc.) or policy vis-à-vis other countries	* No ** Ad hoc benchmarking exercises *** Benchmarking is a systematic process and results are incorporated into policy.	*
Implementing policy cooperation with other countries: bilateral or multilateral programs on innovation, etc.	* No formal cooperation exists. ** Common innovation actions respond to specific opportunities. *** Many long-term agreements exist.	***

3.4 Learning from good practices in innovation and competitiveness policies

The Yozma program, designed to create a local VC industry from a very limited starting base, became outstandingly successful. After several years, the newly set-up VC firms completely bought out the government. Many countries in Europe and elsewhere have subsequently endeavored to adapt policies based on Israel's Yozma program. Yozma established a number of venture capital funds that were initially funded by the government but which also included local and foreign private investors. The private investors were offered to buy Yozma shares in these funds after five years, at a predetermined price. Yozma succeeded in attracting prominent foreign multinational investors (the likes of Advent of Boston, GAN of France, Daimler-Benz of Germany, and the China Venture Management of Taiwan), who brought with them not only their financial resources, but more importantly, their expertise.

Shortly after its establishment, Yozma managed to set up 10 venture capital funds and helped raise close to $200 million. In 1997, its direct investment portfolio was privatized, and thus its mission came to an end. Since then, the venture capital market in Israel has boomed, boasting more than 80 funds in operation, and has raised close to $10 billion during 1993–2000, with actual VC-backed investments reaching a high of 2.7% of GDP in 2000 (a world record). In addition, capital markets have greatly expanded in Israel since the mid-1990s, and international access has improved dramatically. For example, Israel has the largest number of IPOs for a foreign country in NASDAQ.

This burst of funding sources implies that government support for R&D can confine itself to its original role of subsidizing innovation in order to bridge the gap between the social and private rate of return, without having to take on any further financial role (Trajtenberg, 2006).

The nature of Israel’s innovation policy cannot be understood out of its context and timing. This must be considered by other countries when assessing the possibility of learning and adopting components of this policy. Israel’s innovation policy can be seen as the infrastructure that supports underlying entrepreneurial drive and creativity. This drive is the heart and soul of Israeli innovative performance.

Part 2: Cultural aspects of Israeli innovation

In April 1996, *Newsweek* magazine published an article on Israel stating: "The land of milk and honey has become a land of tech and money"; the subtitle read: "Silicon Valley really has only one rival outside the United States—Israel."

Although Israel has a relatively small population of seven million, the country is the second largest supplier of NASDAQ-listed companies after the US and Canada.[19] Despite many security risks, constant political confusion, and significant geographical distance from any major customer markets, the Israeli people have demonstrated an ability to adapt to a challenging environment while building superior companies. The Israeli culture, psyche, military experiences, ambition, and entrepreneurial drive create a multitude of opportunities for creativity and innovation. A unique combination of cultural traits, government intervention, increased immigration, and macroeconomic factors drive this achievement (Rozenrot, 2005).

The Israeli innovation system could not reach its achievements if not for the entrepreneurial spirit of the Israeli people and the cultural values that they share.

In the current chapter, we attempt to portray some of the unique characteristics of Israeli society and Israeli organizations, and point to various environmental conditions that exist in Israel that favor processes of entrepreneurship and innovation.

4. Israeli culture in support of innovation

"Culture" is best defined as "a shared meaning system" (Hofstede, 1980). Culture shapes the core values and norms of its members. Managers and employees in different cultures bring to their workplaces the codes of behavior and norms of their own cultures. In 2004, a group of more than 80 researchers, headed by Robert House from the Wharton School of the University of Pennsylvania, joined efforts to conduct the GLOBE Study in 60 different countries (Hofstede, 1980). The study assessed differences and similarities in cultural and organizational values.

The GLOBE Study determines the two values that capture most of the variance among cultures: "collectivism versus individualism" which portrays the level of interrelatedness among members of one culture; and "power distance" which reflects the level of equality in a society (Erez, 2000).

Collectivism versus individualism: In a collectivist society, the interest of the group prevails over the interest of the individual. The opposite is true in an individualistic society. The United States, Australia, and England are highly individualistic cultures, whereas South America, Japan, and Taiwan are highly collectivistic. In the early years of the State of Israel, the economy was mostly centralized, directed, and collectivistic. Since that time, the central government has shed a considerable part of its power and

[19] Nasdaq.com listings (as of 7/18/2005).

Israel has gradually turned from a deliberate economy into a free economy. In parallel, the Israeli identity has shifted from a coherent collectivist identity to a more diversified and individualistic identity (Ohana, 1998). The cultural value of individualism seems to be relevant to entrepreneurship, since many of the traits identified as characterizing entrepreneurs seem to describe an individualistic orientation: autonomy, independence, assertiveness, self-confidence, initiative, decisiveness, competitiveness, high achievement motivation, need for control, internal locus of control, and risk taking (Malach-Pines, 2005).

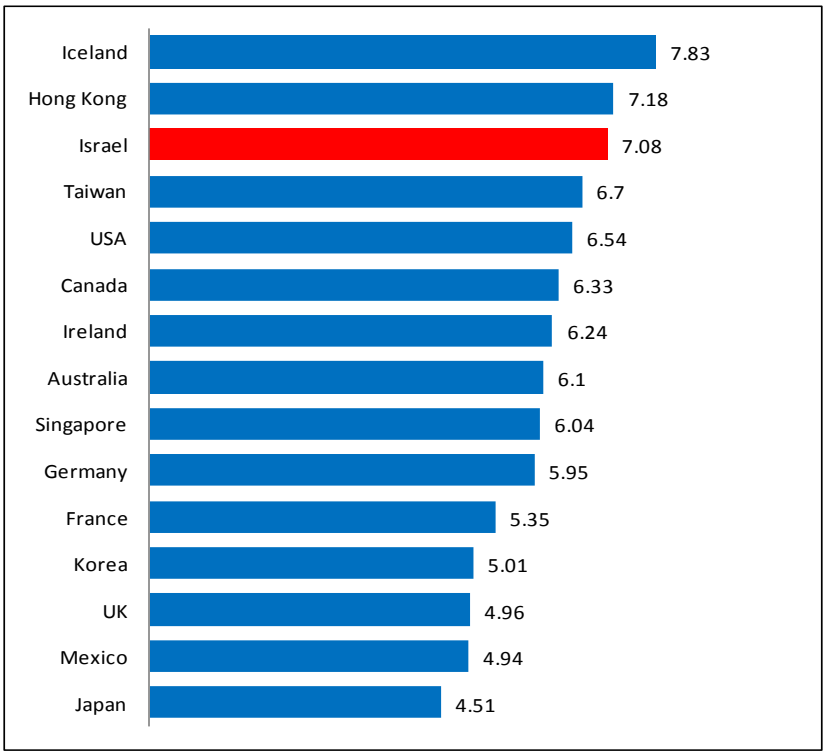
Power distance: High power distance means low equality in a society and a clear power structure in its organizations. Employees in such cultures know their place within the organizational hierarchy, and there are clear status symbols that differentiate between employees at different organizational levels. On the other hand, in low power distance cultures, employees feel free to disagree with their superiors and to express their ideas openly. Malaysia, the Philippines, and India are known for their high level of power distance; Israel, Scandinavia, and New Zealand, on the other hand, are known for their low levels of power distance.

Highly egalitarian cultures, such as that of Israel, influence the level of employees' participation in decision-making processes in an organization and encourage individuals to search for new ways of dealing with problems, take risks, and explore their ideas even when the outcome value is not clear (Brodai, 1998). Other traits used to describe entrepreneurs and innovators were found to characterize Israelis. Thus, in Israel, personal strength stemming from a solid inner-core of decisiveness is considered a crucial aspect of a mature identity (Katriel, 1992). Daring or "chutzpah" (Pines, 1978 quoted in Zimbardo, 1990), self-enhancement, independence, independent thinking, self-confidence, and assertiveness are highly respected in Israel (Katriel, 1995).

5. Entrepreneurship in Israel

Israel is ranked high on entrepreneurship. About one in every 30 adults in Israel invests in new business start-ups, creating an angel business investment rate that is among the highest in the world (Griver, 2000). In Figure 2, which presents the overall entrepreneurship ranking according to the IMD World Competitiveness Yearbook of 2007, Israel is ranked third, after Iceland and Hong Kong, and well ahead of the US, Canada, Ireland, France, Germany, the UK, and Japan.

Figure 2: Overall entrepreneurship ranking in 2007[20]



The definition of innovation as the successful implementation of creative ideas by an organization, distinguishes between the generation of new ideas and their implementation (West, 2002). While creativity is the personal characteristic that is most clearly associated with the generation of new ideas and innovation, one must also demonstrate a high level of initiative to bring ideas to the implementation stage (Amabile, 2000). Israeli entrepreneurs thrive on taking bold steps and high risks. They take into account that they can fail without being stigmatized, and thus they regroup to begin new firms, with a stronger experience basis (Haour, 2005). The necessity of dealing with demanding deadlines without sufficient resources, vague guidelines, and constant changes in objectives cause many individuals to become self-confident improvisers with a multidisciplinary perspective on complicated issues. These traits are precisely those required to achieve innovation and succeed in the start-up world.

The emergence of successful high-tech entrepreneurs as Israel's new culture heroes, and the successes of some start-ups (such as Mirabilis and Chromatis), have strongly promoted an ongoing entrepreneurial spirit and encouraged young people to consider entrepreneurship as the preferred career path, thereby creating a strongly supportive culture. Other characteristics of the Israeli existence that favor the process of entrepreneurship are plurality of culture (multiple spoken languages, cross-cultural wealth), the ability to adapt very quickly (more than 75% of start-ups develop a business that is different from their initial "idea"), and the ability of new businesses to "think global" from day one. Indeed, they have no choice, as the absence of a

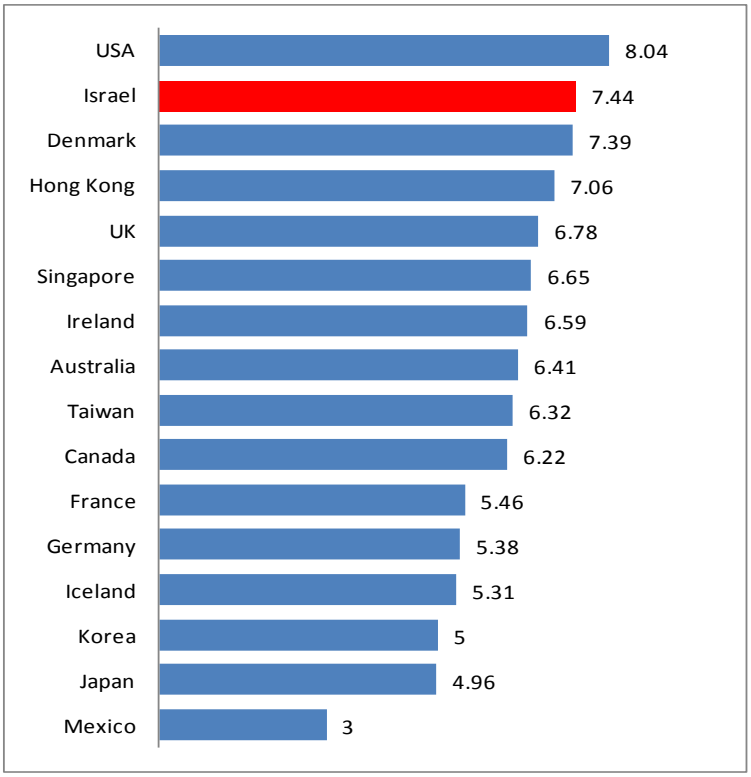
[20] Source: Institute for Management Development, The world Competitiveness Yearbook 2007

significant local market forces companies to integrate this last component into their strategy right from the very beginning (Guegan, 2000).

6. High-tech contribution to Israeli innovation

High-tech is a major driver in the Israeli economy, boasting a growth rate that is the highest of all Israeli industrial sectors. High-tech contributes 75% of the growth of the Israeli Gross National Product (GNP).[21] Israel has the highest number of start-ups in the world relative to its population. Out of about 4,000 high-tech companies in the country, about 1,500 are start-ups[22] and over 40% of the start-ups are financed by venture capital (VC) funds. As a percentage of GDP, Israel has the world's highest level of VC. Figure 3 illustrates the venture capital ranking according to the IMD World Competitiveness Yearbook of 2007.

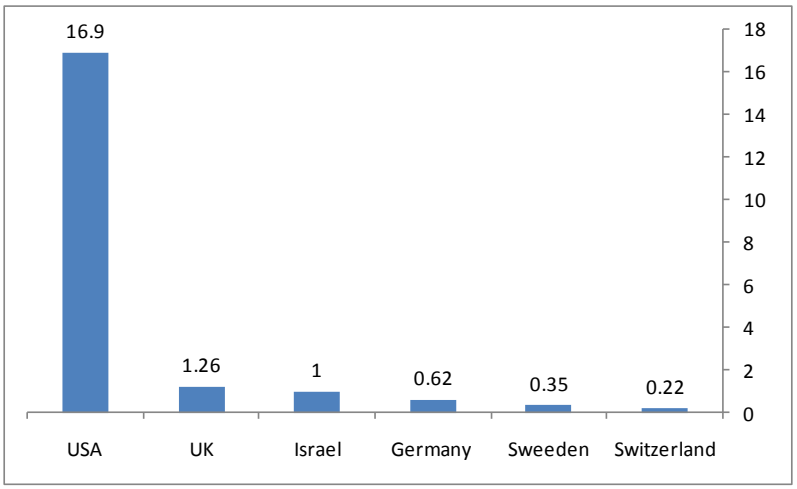
Figure 3: Venture capital ranking in 2007[23][24]



As shown in Figure 4, the size of the Israeli VC industry is similar to that of the UK, which has a much larger economy. On a per capita basis, Israel's VC activity is by far the most intense in the world.

[21] Israel Central Bureau of Statistics, 2001.
[22] Israeli Ministry of Industry and Trade.
[23] Source: Institute for Management Development, The world Competitiveness Yearbook 2007.

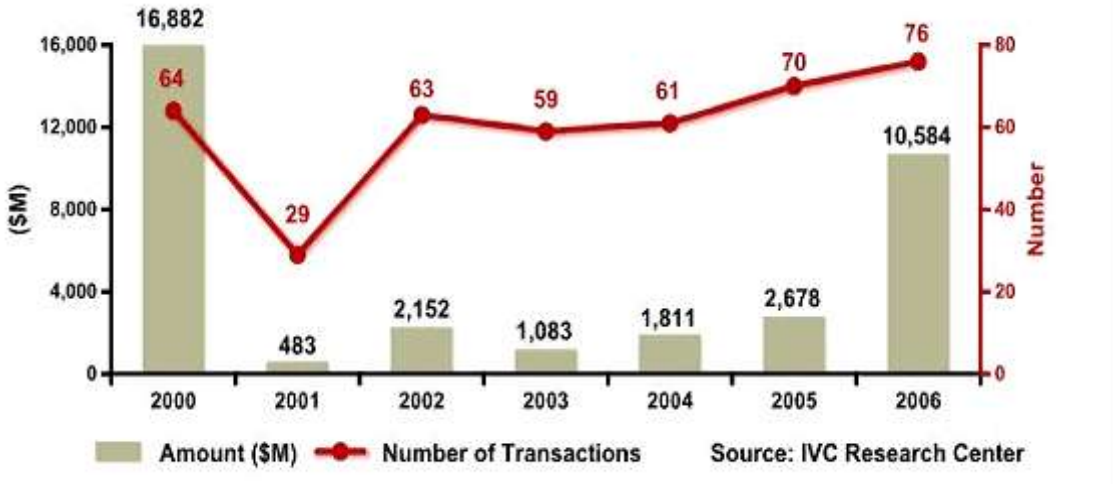
Figure 4: Venture capital raised by country in 2003 (in $b)



Most of the VC funds tend to invest in the initial stages of a firm's life. VCs are much more than just a way of financing new high-risk ventures: they provide expert screening, global connections, managerial expertise, and so on. Still, statistics show that only 10% of start-ups succeed.

In 2006, acquisitions of Israeli technology companies exceeded $10 billion, and many Israeli companies dramatically increased their sales (by dozens, or even hundreds of percents), rendering them extremely attractive for potential future exits.

Figure 5: Capital raised via mergers and acquisitions of Israeli high-tech companies



Multinationals are another important element of the innovation-led "ecosystem," as large firms provide start-ups with a "window" to the world's markets: by contacting these companies in Israel, managers of local start-ups can obtain advice and market intelligence on relevant businesses worldwide. These multinationals may also act as references, partners, and customers for the start-ups (Haour, 2005).

In the following sections we describe the three main factors that are frequently viewed as most contributing to making Israel one of the few countries in the world that are exceptionally good at generating innovation: Israeli government policy, the Israel Defense Forces (IDF), and immigration to Israel.

7. The role of government funding in Israeli innovation

Leaders of the Israeli economy acknowledge that entrepreneurship can provide the country with a competitive advantage. But entrepreneurs' ideas are not enough. In order to turn an idea into innovation, one needs a support system and funding sources. The Israeli government identified a bottleneck for innovation, namely, research and development. Thus, since the early 1970s, huge efforts have been invested in direct support for mostly small firms and small industries in their research. This has generated an enormous amount of research by small companies, leading to new ideas—many of which became the basis for start-ups and companies.

Israel makes the highest investments in research and development in the world, totaling almost 5% of the country's Gross National Product, compared with the OECD average of 2.5%. As a result, Israel's workforce includes 138 R&D professionals per 10,000 employees—about three times the ratio in the UK, for instance. In addition, most government ministries have a chief scientist to encourage the commercialization of science and technology in their respective area of responsibility. At the same time, the government also sponsors bilateral agreements with many countries on joint research projects. Israel has exchange programs with 15 different countries, which also puts the country on the global map with respect to exposure to technologies and ideas (Peretz, 2002).

In the early 1990s, the government initiated several programs to support and offer entrepreneurs an opportunity to develop their innovative technological ideas and set up new businesses in order to commercialize them. Two examples of these programs are the technological incubators and Yozma. The technological incubators nurture novice entrepreneurs at the earliest stages of technological innovation, help them implement their ideas by turning them into exportable commercial products, and assist in forming productive business ventures. By absorbing a large portion of the risk at this early stage, the technological incubators provide entrepreneurs with physical premises, financial resources, tools, professional guidance, and administrative assistance so that, during their stay in the incubator, they can turn their abstract ideas into products that hold feasibility, novelty, and advantages sought in the international marketplace. Yozma, an outstandingly successful program, was designed to create a local VC industry from a very limited starting base. It established a number of venture capital funds that were initially funded by the government and which included local and foreign private investors. Since then, the venture capital market in Israel has developed to include over 100 active funds collectively managing over $12 billion.

8. The role of the IDF in the Israeli innovation system

The IDF is often credited for playing a major role in the continuous success of the Israeli high-tech industry. Many entrepreneurs are people who retired from the military after several years of service and many start-ups are based on technical innovations that originated in the army. In most cases, the founders were directly involved with the particular technology during their military service (Haour, 2005).

Military service is compulsory in Israel; therefore, the IDF is the first employer of the majority of secondary school graduates. At the age of 18, when most young people in Western countries start college or enter the labor market, their Israeli peers begin an extended period of military service (Gal, 1986). Away from their familiar and supportive circles of family and peers, the conscripts enter a social system characterized by diverse physical, emotional, and interpersonal situations and new social and cultural encounters. As they shift places and roles, they are faced with learning experiences and challenges that require cultivation and development of new skills and capacities. The military is conducive to multifaceted experiences with a variety of physical, mental, interpersonal, and professional tasks in a system of rapid mobility between tasks, roles, and places (Dar and Kimhi, 2001). Commanders rise through the ranks solely on the basis of their leadership and command capabilities. The IDF typically entrusts its soldiers with highly responsible jobs. Thus, young soldiers manage projects with sizable budgets and carry out work for which quality, reliability, and resilience under stress are paramount. The system allows youth to grow and maximize their potential; the demands of the job help make the young "managers" more mature and capable of learning a great deal rapidly.

Lieblich (1989) examined the impact of military service, through retrospective interviews with male veterans attending university. Respondents reported improved problem-solving capacity, better ability to cope with physical difficulties and emotional tensions, enhanced independence, self-confidence, and a greater willingness to take responsibility. Experience with critical events, encounters with moral dilemmas, and exposure to different ethnic cultures broadened the soldiers' personal and social horizons. Breznitz (2002) found that the IDF's Center of Computing and Information Systems (MAMRAM) and School for Computer Professions have a prominent influence on the Israeli software innovation system. They create skilled human resources and train a large number of developers and users, who are exposed to cutting-edge technologies and are released into the private market at very young age.

As a small country in a hostile security environment, Israel has always strived to maintain a strong military advantage over potential aggressors. Previous wars, weapon embargoes, and general difficulties in acquiring the necessary military technologies have all taught the country's inhabitants an important lesson: self-reliance.

The Israeli defense industry is a result of this lesson. The army regularly invests large amounts of money in research and development. The effort to gain military independence reached its limits in the mid-1980s, when Israel tried to develop the

Lavi jet fighter. The cost proved beyond the state's capabilities and the project was abandoned, causing hundreds of engineers with experience in advanced technologies in aerodynamics, avionics, and electronics to flood the marketplace. The demise of the Lavi fighter project has been described as a powerful boost to the Israeli high-tech industry. After the Lavi, the Israeli defense industries shifted their focus to advanced systems designed to be installed in acquired American or other platforms. Development of these auxiliary systems provided local high-tech industries with an advantage in producing civilian spin-offs in areas of security, electronics, software, and internet (Rozenrot, 2005).

9. Immigrants' contribution to the innovation system

From the last quarter of 1989 until 2001, more than a million immigrants from the former Soviet Union (FSU) arrived in Israel, increasing the country’s population and workforce by extraordinary rates. This immigration wave included 11,000 talented and skilled scientists and research engineers with advanced training from top universities. Almost immediately, the skilled manpower in Israel doubled, with a considerable impact on Israel's technological labor market (Paserman, 2007). Immigrants helped fuel Israel's GDP growth from $11,000 per capita in 1990 to $17,000 per capita in the year 2000, while increasing the business sector product growth by 107%. Most of all, the immigrants brought with them knowledge that Israeli entrepreneurs could embed in their technology-intensive ventures.

Summary

The Israeli government plays an important role in the successful Israeli innovation system with innovation policies that foster scientific and technological creativity and cultivate the state's human capital.

The OCS at the MOIT together with many other Israeli government ministries, are responsible for overseeing the different elements of this national policy and its execution. These ministries operate various programs that extensively finance and enable the implementation of long-term national and international R&D and innovation policies.

The thriving landscape of advanced R&D and high-tech industry in Israel can also be attributed to the country’s demanding and resilient emphasis on technological education and its nonstop investment in new technologies.

Israel constitutes a remarkable model of high entrepreneurial energy, enthusiastic risk taking, and boldness of innovation. The country's basic cultural climate and its innovative system have created a framework that supports underlying ambition, openness, and entrepreneurial drive. The waves of post-Soviet immigration to Israel brought skilled scientists and research engineers, and the IDF acts as a sustained source of skilled human resources and technological innovation. The unique combination of these characteristics creates a multitude of opportunities for entrepreneurship and innovation in Israel.

References

Amabile, T. M. (2000). Stimulate creativity by fueling passion. In Locke, E. (2000). *Handbook of Principle of Organizational Behavior*, pp. 331–341. Malden, MA: Blackwell.

Arnold, E., Boekholt, P., Deiaco, E., McKibbin, S., De la Mothe, J., Simmonds, P., Stroya, J., and Zaman, R. (2003). Research and Innovation Governance in Eight Countries, A Meta-Analysis of Work Funded by EZ (Netherlands) and RCN (Norway). *Technopolis*, January, p. 55.

Avimelech, G., and Teubal, M. (2005). Evolutionary innovation and high-tech policy: What can we learn from Israel's targeting of venture capital? *Science, Technology, and Economy Program (STE) Working Papers Series*, 25. Samuel Neaman Institute for Advanced Studies in Science and Technology, Technion—Israel Institute of Technology.

Bank of Israel Annual Report (2006). http://www.bankisrael.gov.il/deptdata/mehkar/doch06/eng/summ06e.htm#part2

Ber, H. (2002). Is venture capital special? Empirical evidence from a government initiated venture capital market. *Science Technology and Economy Program (STE) Working Papers Series*. Samuel Neaman Institute for Advanced Studies in Science and Technology, Technion—Israel Institute of Technology.

Branscomb, L. M., and Auerswald, P. E. (2002). Between invention and innovation: An analysis of funding for early-stage technology development. The Advanced Technology Program, National Institute of Standards and Technology.

Breznitz, D. (2002). The military as a public space—The role of the IDF in the Israeli software innovation system. *Science Technology and Economy Program (STE) Working Papers Series*. Samuel Neaman Institute for Advanced Studies in Science and Technology, Technion—Israel Institute of Technology.

Brodai, A. (1998). Similarities and differences in preferred coping styles in the eyes of Israeli adolescents from different cultures. *The Educational Counselor*, Vol. 7, pp.37–75.

Central Bureau of Statistics (2006). http://www1.cbs.gov.il/reader/?Mlval=cw_usr_view_Folder&ID=141>,2006

Cohen, M. (2003). European trend chart on innovation. Country report: Israel. Covering period: September 2002–August 2003.

Cohen, M. (2004). European trend chart on innovation. Country report: Israel. Covering period: September 2003–August 2004.

Dar, Y., and Kimhi, S. (2001). Military service and self-perceived maturation among Israeli youth. Journal of Youth and Adolescence, 30(4), pp. 427–448.

Erez, M. (2000). Make Management Practice Fit the National Culture. In Locke, E. A. (ed.). *Basic Principles of Organizational Behavior: A Handbook*, pp. 418–434. NY: Blackwell.

EU (2002). Innovation Tomorrow. Innovation Policy and the Regulatory Framework: Making Innovation an Integral Part of the Broader Structural Agenda. Available at http://cordis.europa.eu/innovationpolicy/studies/gen_study7.htm

Fagerberg, J. (2005). Innovation: A Guide to the Literature. In Fagerberg, J., David, C., Mowery, C., and Nelson, R. R. (eds.). *The Oxford Handbook of Innovation*, pp. 1-26. Oxford: Oxford University Press.

Frenkel, A., and Leck, E. (2006). Investments in higher education and the economic performance: Israel in an international perspective. Samuel Neaman Institute for Advanced Studies in Science and Technology, Technion—Israel Institute of Technology.

Gal, R. (1986). A portrait of the Israeli soldier. Westport, CT: Greenwood.

Getz, D., and Kahane, B. (2002). How users build the innovation partnerships they need. Samuel Neaman Institute for Advanced Studies in Science and Technology, Technion—Israel Institute of Technology.

Getz, D., and Kahane, B. (2003). Users involvement in R&D consortia: Israel as a showcase. Samuel Neaman Institute for Advanced Studies in Science and Technology, Technion—Israel Institute of Technology.

Gibbons, M. (1999). Science's new social contract with society. *Nature*, Vol. 402. Macmillan Magazines Ltd.

Griver, S. (2000). The Entrepreneur—Israel's Newest Culture Hero. http://www.mfa .gov.il/MFA/Israel%20beyond%20the%20conflict/The%20Entrepreneur%20-%20Israel-s%20Newest%20Culture%20Hero

Grupp, H., Maital, S., Frenkel, A., and Koschatzky, K. (1992). A data envelopment model to compare technological excellence and export sales in Israel and EU countries. *Research Evaluation* 2(2), pp. 87–101.

Guegan, N. (2000). Growth Entrepreneurship and Venture Capital in Israel. *INSEAD working paper*. France: INSEAD.

Haour, G. (2005). Israel, a powerhouse for networked entrepreneurship. *International Journal of Entrepreneurship and Innovation Management,* 5, 1/2, pp. 39–48.

Hemar, A., and Refuah, S. (2002). European trend chart on innovation. Country report: Israel. Covering period: 2002.

Hofstede, G. (1980). *Culture's Consequences: International differences in work related values*. Newbury Park, CA: Sage.

Institute for Management Development. (2007). The World Competitive Yearbook 2007, IMD.

Israel Central Bureau of Statistics. (2007). http://www1.cbs.gov.il/reader/cw_usr_view_Folder?ID=141

Israeli Ministry of Industry and Trade. (2007). http://www.moit.gov.il/NR/exeres/B0B48981-357D-446F-AFAC-91A358E93C87.htm

Israel National Nanotechnology Initiative (INNI). http://www.nanoisrael.org/

Israel Venture Capital Research Center. Capital Raised by Israeli High-Tech Companies in Q2 2006. Available at http://ivc-online.com/upload/archive/survey/Q2-06.pdf

Katriel, T. (1995). *Communal Webs. Communication and Culture in Contemporary Israel*. New York, NY: State University of New York Press.

Lieblich, A. (1989). Transition to adulthood during military service. Albany, NY: State University of New York Press.

Malach-Pines, A. (2005). Entrepreneurs as cultural heroes: A cross-cultural, interdisciplinary perspective. *Journal of Managerial Psychology*, 20(6).

MATIMOP, Ministry of Industry, Trade and Labor. (2007). The technological incubators program—establishing start-up companies from innovative ideas.

Meser, O., and Maital, S. (2001). A survey analysis of university-technology transfer in Israel: Evaluation of projects and determinants of success. *Journal of Technology Transfer*, 26, pp. 115–126.

NASDAQ. http://www.nasdaq.com/

OECD. (2002). Dynamising National Innovation Systems. Paris: OECD.

OECD. (2004). Knowledge Management Innovation in the Knowledge Economy. Implications for Education and Learning. Paris: OECD, Centre for Educational Research and Innovation.

OECD. (2005). Governance of Innovation Systems, Vol. 1: *Synthesis Report*, p. 10. Paris: OECD.

Ohana, D. (1998). *The Last Israelis*. Tel Aviv: Hakibutz Hameuchad (Hebrew).

Paserman, M. D. Do high skill immigrants raise productivity? Evidence from the Israeli manufacturing firms, 1990–1999. *Science Technology and Economy Program (STE) Working Papers Series*. Samuel Neaman Institute for Advanced Studies in Science and Technology. Technion—Israel Institute of Technology.

Peretz, L. (2002). Innovation: The Israeli approach. The Buzz, Radio National. 25 November 2002. http://www.abc.net.au/rn/science/buzz/stories/s734653.htm

Pines, A. M., Dvir, D., and Sadeh, A. (2004). The making of Israeli high technology entrepreneurs: An exploratory study. *Journal of Entrepreneurship*, Vol. 13, No.1, pp. 29–52.

Radosevic, S. (2004). Foresight as S&T and Innovation Policy Tool: Policy Lessons from Bulgarian, Czech and Hungarian Foresight Exercises. Paper prepared within the FORETECH project, mimeo. Available at http://foretech.online.bg/docs /AnalyticalComparison_PolicyImplications_SR_May2004.pdf

Rosenbaum, B., Ardetz, M., Getz, D., Shafer, D., Frenkel, A., and Stones, H. A. (2007). Israel's nanotechnology research landscape: A survey of Israeli nanotechnology capabilities and technology transfer policies. Electronic version. *Nanotechnology Law & Business*, 4(1). http://www.nanolabweb.com/index .cfm/action/main.default.viewArticle/articleID/182/CFID/478147/CFTOKEN/18651548/index.html

Rozenrot, E. (2005). *Note on private equity in Israel*. Center for Private Equity and Entrepreneurship, Tuck School of Business at Dartmouth College.

Teubal, M., Moser, N., Rosenzweig, Y., and Levin, C. (2005). European trend chart on innovation. Annual Innovation Policy Trends and Appraisal Report—Israel, 2004–2005.

Trajtenberg, M. (2005). Innovation policy for development: An overview. *Science, Technology, and Economy Program (STE) Working Papers Series*. Samuel Neaman Institute for Advanced Studies in Science and Technology, Technion—Israel Institute of Technology.

Trajtenberg, M. (2006). Innovation policy for development: An overview. *Science, Technology and the Economy program (STE) Working Papers Series*, 34. Samuel Neaman Institute for Advanced Studies in Science and Technology, Technion—Israel Institute of Technology.

UNCTAD. (2006). World Investment Report: Internationalization of R&D. United Nations, New York and Geneva.

United Nations Economic Commission for Europe. (2007). *Creating a conducive environment for higher competitiveness and effective national innovation systems. Lessons learned from the experiences of UNECE countries*. United Nations, New York and Geneva. http://www.unece.org/ceci/ic.html

Watzman, H., and Petersen, S. (2001). Israel's great expectations. *Nature Biotechnology*, 19, pp. 518 –520. http://www.nature.com/nbt/journal/v19/n6/full /nbt0601_518.html

Zimbardo, P. G. (1990). Shyness: What it is. What to do about it. Reading, MA: Addison-Wesley. pp. 216–19.

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