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The Emergence of "Silicon Wadi"

Introduction

For decades since Israel declared independence on May 14, 1948, it was a high-risk country, facing political and economic crises. Politically, Israel fought wars with its neighbors in 1948, 1956, 1967, 1973 and 1982. Israel's geo-political unrest was exacerbated by the rise of the Palestinian Intifada in 1987 and terrorist attacks within the internal borders of Israel.

Israel also struggled to achieve economic stability. Israel had almost no natural resources, such as arable land, oil or low-cost labor. The population was small and its landmass was approximately equivalent to the size of New Jersey. During Israel's early years (1950s-1970s), Israel was highly influenced by its socialist founding fathers. Government hostility existed toward business and socialism was favored. The government and/or Israeli unions owned over 50% of Israel's industry, with much of the rest being indirectly controlled by the government through large banks. There was little regard for efficiency or profitability since there was strong economic growth and demand outstripped production capacity. This centralized and protectionist economy plunged into crisis during 1973 to 1984, when Israel experienced hyperinflation (300% in 1984 and 400% in 1985), slow growth, currency volatility and a major stock market crash of 1983 in the Tel Aviv Stock Exchange. These events, combined with the Arab boycott, these events made foreign investment in Israel nearly negligible.

In spite of these challenges, Israel surprisingly emerged in the 1990's as a world powerhouse in the arena of high technology, creating what became known as "Silicon Wadi."[1] Between 1992 and 1997, Israeli companies, chiefly high-technology companies, raised $3.5 billion on Wall Street. In 1996, Israeli firms provided the largest number of IPOs on the NASDAQ in New York, after the US and Canada and the 2nd largest number of IPOs on the relatively new AIM (Alternative Investment Market) in London (after the UK)[2] (see **Exhibit 1**).

Silicon Wadi emerged because by the 1990's Israel's business opportunities outweighed its country risk. Government programs, positive socio-political background conditions and cultural

[1] "Wadi" refers to a gully or dry riverbed in Arabic and Hebrew.

[2] www.israel.org/mf/go.asp?MFAHO1vuO

Professor Paul A. Gompers and Research Associate Sara Bergson prepared this note as the basis for class discussion.

influences created the necessary ingredients of deal flow ideas and sources of funding for Israel to benefit from innovation.

Government Strategies that Influenced Israeli Innovation

Military Spending on R&D Before 1967, Israel was nearly entirely dependent on foreign support for the acquisition of new technology. In the aftermath of the 1967 war, France, who supplied most of Israel's military equipment during the war, imposed an embargo on all technological imports. At that point, the Israeli government made a strategic decision to reduce its dependency on foreign technology.

Israel invested billions of dollars in military R&D and manufacturing to achieve technological supremacy versus its potential enemies in communications, network security, weaponry and electronics. The elite units and military departments created, such as Unit 8-200[3] and Mamram[4], required large numbers of workers to develop a skilled and experienced technologically inclined workforce. The IDF recruited and select the brightest math and science high school students to these units. These soldiers were provided with state of the art training and given the freedom to creatively develop their ideas. The military spending also helped lead to the growth of local technology companies in the commercial sector. For example, Blades Technology, a company originally set up to manufacture engine parts now earns revenue in the civilian realm.

Move to Market-Based Economy Faced with economic crises throughout the early 1980s, the Israeli government initiated rigorous economic reforms in 1985. Through fiscal and monetary policy changes, Israel tightened their credit, raised interest rates and reduced inflation to low double-digit figures. De-regulation, privatization and liberalization led to greater confidence in Israel's economic credibility and an embracing of capitalism, even as it increased competition and unemployment through weeding out weaker businesses. By 1990s, Israel's moved to market-based economy showed some improvements on key economics indicators.

Israel determined that it had potential in developing competitive advantage by creating and sustaining a highly educated work force. The government continued to make education a priority in its spending and developed one of the most educated workforces in the world (see **Exhibit 2**). Education in Israel was compulsory and tuition-free for ages five to fifteen. After military spending, education is the highest category of national budget spending (see **Exhibit 3**).

The link between universities and industry has been critical in commercializing technology. Industrial parks adjacent to university campuses were first started in the 1960s and Israel had some of the first academic organizations that formally commercialized research. These programs spread throughout all of the academic campuses in Israel by the 1990s.

Law for Encouragement of Industrial R&D, 1984[5] To promote and accelerate Israel's economic shift, the government passed legislation to create jobs and improve Israel's balance of payments. To fuel these goals the Office of the Chief Scientist at the Ministry of Industry and Trade

[3] Unit 8-200 of the Intelligence Corps was formed in 1959. Established as a research and technology division of the Intelligence Corps. Ever since, graduates of 8-200 have gone on to hold leading positions in Israel's high-technology industries, becoming entrepreneurs and executives in such companies as Checkpoint, Comverse, Jacada and others.

[4] Mamram, IDF's Central Computing Facility, was formed in 1959. Mamram was the pioneer in computers in the IDF. At the beginning, Mamram supplied the IDF with computer services. Over the years, computer subdivisions opened

[5] Information in this section is primarily taken from www.moit.gov.il.

was founded to assist Israeli high-tech enterprises in realizing their potential through risk sharing. These programs nurtured innovative companies, stimulating R&D and increasing cooperation between the military, academia and industry. Since capital was difficult to attain OCS created a range of international and national programs, offering grants (funding of up to 85% of R&D costs) to recipients that were repayable through royalties should there be commercial revenues arising from the project (see **Exhibit 4**).

1. International programs encouraged other countries to participate in the Israeli information technology revolution. These programs could be divided into four major areas:

    - *Bi-national Funds* involved two nations contributing a pre-determined sum of money to support and promote joint industrial R&D collaboration between firms of each country. The fund is instrumental in helping to pair companies together to jointly apply. Bi-national Funds existed between Israel and the United States (BIRD Foundation established in 1977 with $110 in endowments equally contributed by both governments), Canada (established 1994 – each government contributes $1 million/year), Singapore (1996 - $1 million/year for 3 years) and South Korea (1997) and Britain (1999- 15.5 million pounds)

    - *Bi-national Agreements* are relationships with countries to set guidelines to support joint R&D projects. Countries that participated include: Austria, France, the Netherlands, Spain, Belgium, Germany, Ireland, Portugal, China, Hong Kong and India

    - *US-Israeli Science and Technology Commission* promoted cooperation of the government, private sector and academia in order to adapt military technology to civilian production. In 1993, the United States and Israel each committed $15 million for 3 years to fund high-risk technology & commercialization projects, on-going panels provided an on-going forum to identify and remove impediments, as well as, build infrastructure to foster mutual technological and economic progress for both nations.

    - *EC's 4th Framework Program (Eureka)* In 1996, Israel was accepted as the first non-European country to become a full participant in research endeavors funded by the European Commission under Fourth Framework Program for research, technological development and demonstration. With 29 members, Eureka is a network promoting to fund and drive cross-country R&D projects.

2. National programs support Israeli ventures through all stages of financing needs, form incubation to exit. They encourage cooperation between academic institutions, government entities and private enterprises and also sought to develop a sustainable source of funding for entrepreneurs.

    - *MAGNET or "Generic Pre-Competitive Technologies and R&D"*, launched in 1992, aimed to drive intensive large-scale cooperation between academic research institutions and industrial companies in basic technologies, manufacturing methods and standards that had wide-ranging applications in numerous industries. Through these alliances costs were cut, manpower s saved and synergistic relationships helped to focus, strengthen and expand technological activity to the mutual benefit of all. Includes 18 consortia (made up of industrial companies and academic institutes) and 2 associations that identified future technologies the organization wanted to explore.

    - *MATIMOP*, the Israeli Center for Industrial Research & Development, was the national contact for the bi-lateral industrial R&D programs between Israeli companies and international activities. The organization provided databases listing hundreds of

companies looking for foreign high-tech partners. It also published a bi-monthly newsletter about Israeli technology circulated worldwide.

- Industrial and Technological Incubators aimed to nurture firms at the nascent stage, encouraging novice entrepreneurs that were not yet ready for private investors. The goal was to prevent promising ideas from going to waste due to lack of resources and guidance. The 24 incubators in Israel offered grants, infrastructure, guidance and administrative assistance. Similar programs aimed at different levels of financing stages, included programs for improving existing projects, sustaining start-ups and creating beta-sites.

- Support for Joint Ventures and Multi-national Industries encouraged cooperation between entrepreneurs who needed the experience and support of successful companies

import knowledge through policy

- Encouragement of Foreign Direct Investment offered economic incentives through tax and customs benefits to foreign corporations, including grants from the government. Companies such as Intel (1974), IBM (1972) and Microsoft (1991), to mention just a few have set us subsidiaries, research centers, invested in Israeli companies and formed strategic partnerships. Annual Foreign investment in Israel grew from $0.4 billion in 1992 to $2.36 billion in 1997.[6] Israel also started to strengthen existing laws and created new regulations to bolster its policies in the Information Technology sector. For example, in 1995, Israel amended its 1965 Patent Law to begin to protect computer programs or any other software via patents. International firms which established local R&D centers in Israel in the 1970s and 80s brought the know-how and operating procedures of large conglomerates to local, inexperienced firms – exposed Israeli industry to new areas of industry and practice.

Government Influence in the Creation of VC Funding The programs outlined by the OCS, especially BIRD in the 1970s, created foreign and national investment in early stage financing for technology ventures. These were the precursors to modern venture capital in Israel but by 1992 there were still only two professional VC funds with merely $30 million between them. The government created two major programs to stimulate the development of professionally managed, private sector venture capital in Israel.

1. *Inbal* initiated in 1992 to stimulate investment in VC funds from the capital markets through public offerings on the Tel Aviv Stock Exchange. The government protected the downside risk by insuring 80% of the nominal investment for 7-9 years. Due to a guaranteed premium of only 0.2% and tight government regulation that limited its flexibility, the program was discontinued in 1995. The goal was to sponsor the development of a professionally managed Israel's private venture capital industry, stimulate foreign investment and encourage cooperation and knowledge transfer and contacts with experienced international venture corporations.

2. *Yozma Venture Capital Ltd.* established in 1992 as a $100 million venture capital fund wholly owned by the Israeli government. The fund led to investments in 10 private VC (Yozma) funds of $80 million and direct investments in start-up companies of $20 million. Among the conditions for becoming a Yozma fund was establishing an independent Israeli management company with a majority of Israeli managers and engaging a reputable foreign financial institution as well as a reputable Israeli one. A major feature of the Yozma Program was the

[6] www.4hightech.com/how.html

upside incentive of the program – a call option open to partners to purchase the 40% Israeli government share at cost plus an interest rate of 5-7% for a period of 5 years. Total capital raised by the program was $250 million and they invested in over 200 start-up companies.

Socio-Political Shifts that Influenced Israeli Innovation

Socio-political shifts within Israel and beyond combined to form what some have dubbed, the "Israeli psyche". This description has been used to characterize a mix of entrepreneurial spirit, team work, calculated risk taking and creative adaptation which form ingredients common in successful entrepreneurial environments.

Defense Cutbacks Changes in the political environment led to increased funding of and innovation in civilian R&D and to greater foreign investment in Israel's economy. In the beginning of the 1980s, Israel commenced the Lavi project, a plan to build a new fighter jet. However, prohibitive costs led to the program's cancellation in 1987 and 6,000 military technologists at the cutting edge of their fields were sent into the civilian sector. Another boost to the civilian sector was the downsizing in military spending and staff caused by the end of the Cold War and the beginning of regional peace initiatives in 1993 with the Oslo Accord.

Russian Immigration Between 1989 and 1996, a mass Russian immigration of approximately 750,000 people came to Israel. Half of this immigrant population had university degrees, with many of them being highly educated scientists, engineers and technicians. Although the huge influx of immigrants created high unemployment, they also brought with them a surge of knowledge and experience. Israel needed to focus on the technology sector both to create jobs and to harness the talents and experience of the Russians to further develop industry.

Compulsory Military Service All men and women over 18 years old were obligated to serve a mandatory military service. Men serve three years and women serve 8-21 months.[7] Military service fostered practical training in areas of technology and teamwork. These close relationships not only prepared them for the corporate team-oriented environment, but also were sources of potential colleagues that could lay the foundation to start-up companies. Israelis common need to deal with military threats meant that they came to rely on each in ways that formed close bonds and trust. The need for Israel to maintain a military edge over potential enemies, while lacking resources, created an atmosphere of creative problem solving and risk taking.

Social Mobility Within the last 100 years, almost everyone in Israel is an immigrant from somewhere. Many came to Israel with little material wealth and lack of familial ties, having to build their lives anew. Israel is a young country – it's history, culture and edifices are all recent experiences. The notion that you can start over and move through the ranks (both in military and civilian life) and succeed influences Israeli attitudes to take risks and pursue entrepreneurial ventures.

Technological Culture Israelis tend to embrace and adopt new innovations quickly. This creates positive attitude towards technology and is conducive to developing technological skills. For example, Israel has the most cell phones per capita of any other country. Israel is also the most computerized country in the Middle East and surpasses some Western countries with the highest penetration rate of PCs in private homes. There is a personal computer in nearly one out of every 2

[7] Orthodox Jews are not obligated to serve in the army and female mandatory service is less strictly enforced.

households, a ratio similar to that of the United States, Canada and very few European and Far Eastern countries.[8]

lots of thinkers in 1 place

Cluster Cycle Creation Due to the small size of the country, the small size of the population and the high population density, close-knit communities and networks of people are constantly formed. Many of the high technology company teams previously served together in military units (e.g. 8-200 and Mamram). Additionally, the geography of Israel's high tech core is located in 5 cities (Haifa, Herziliya, Jerusalem, Rehovot and Tel Aviv) whose area is not larger than 6,000 square kilometers (1/2 the geographic size of Silicon Valley). This creates a highly concentrated group of individuals and businesses.

Absence of Significant Brain Drain Many developing countries experience "brain drain" where citizens leave their home country to pursue opportunities in the developing countries, depriving their home country of needed skills, capital and experience. Israel is fortunate that many of its citizens, at some point, return to Israel or form connections with Israelis to transfer this international experience into local knowledge.

[8] www.israel.org/mf/go.asp?MFAHO1vuO

Exhibit 1 Number of IPOs of Israeli Companies in U.S. and E.U. Capital Markets

	All Public Offerings			VC Backed Public Offerings		
	# of Offerings[a]	Capital Raised ($M)[b]	# of IPOs	# of Offerings[a]	Capital Raised ($M) [b]	# of IPOs
Before 1993	~ 30	~ 1,000	~ 25	4	~ 60	3
1993	18	529	16	7	103	6
1994	10	336	8	5	25	4
1995	16	608	12	7	210	5
1996	31	1,037	24	13	535	12
1997	24	1,074	16	8	175	5

Source: Compiled by casewriter.

[a]Including IPOs, secondary and debt offering of all Israeli and Israeli-related companies (high tech and non-high tech) that are traded or were traded in NASDAQ

[b]U.S. capital markets only.

Exhibit 2 Concentration of Scientists and Engineers in 1997

	Per 10,000 People in the Labor Force
Israel	136
USA	80
Canada	45
Germany	55
Japan	75
The Netherlands	60
Sweden	52

Source: Office of the Chief Scientists, Israel Ministry of Industry and Trade

Exhibit 3 Economic Data on Selected Countries

	Israel	USA	Canada	Germany	Japan	The Netherlands	Sweden
Economic Indicators							
Population, in millions[a]	5.5	267.9	30.3	82.1	125.7	15.7	8.7
GDP, PPP in US$ billions	97	8,083	658	1,740	3,080	344	176
GDP, per capita in US$ 000s	17.5	30.2	21.7	20.8	24.5	22.0	19.7
GDP, real growth rate	1.9%	3.8%	3.5%	2.4%	0.9%	3.3%	2.1%
Unemployment, %	7.7%	4.9%	8.6%	12.0%	3.4%	6.9%	6.6%
Inflation, %	9.0%	2.0%	1.8%	1.8%	1.7%	2.0%	2.0%
Social Indicators							
Infant Mortality, per 1,000 births	8.3	6.6	5.7	5.3	4.0	5.2	3.9
Life Expectancy at Birth, years	78.2	76.0	79.0	76.8	80.5	77.9	79.1
Concentration of scientists & engineers, per 10K members of labor force	136	80	45	55	75	60	52
Government Finance							
National Expenditure on Education, % of GDP	8.9	6.4	6.2	5.6	4.7	4.6	6.8
National Expenditure on Civilian R&D, per capita	533	645	373	486	705	433	736
National Expenditure on Civilian R&D, % of GDP	2.9	2.2	1.6	2.2	2.9	2.1	3.6
Balance of Payments							
Exports of Goods and Services, US$ billions	20.7	6,251.1	208.6	521.1	421.0	203.1	84.5
Imports of Goods and Services, US$ billions	28.6	822.0	194.4	455.7	339.0	1,791.0	66.6
High technology exports, % of manufactured exports in 1998	19.5	32.9	14.1	14.8	25.6	29.2	19.2
Foreign Direct Investment, net inflows in reporting country, current US$, Bn in 1998	1.7	179.0	22.7	23.6	3.3	37.6	19.4

Source: Compiled by casewriter.

[a]Includes 136,000 Israeli settlers in the West Bank, 15,000 in the Israeli-occupied Golan Heights, 5,000 in the Gaza Strip, and 156,000 in East Jerusalem (8/96 est.)

Exhibit 4 Total Net Venture Capital Raise by Israeli VC Funds

	$ Millions
1992	81
1993	204
1994	113
1995	145
1996	264
1997	630

Source: Compiled from IVC Research Report, 2002