

Study by the Royal Swedish Academy of Engineering Sciences:

Technology Transfer between Industry, Academia and Defense in Israel

**by
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December 4, 2000.

Abstract

The Royal Swedish Academy of Engineering Sciences is performing a global investigation into the factors behind successful technology transfer, and the mechanisms driving it.

In Israel, the high-tech industry is today the most successful economic activity due to the convergence of a number of contributing factors acting in concert. The high-tech industry is today driven by networks between academia, defense R&D, military industry, civilian industry and venture capital. This report aims to give an insight into the Israeli high-tech environment and some of the mechanisms behind its success. In the present study, the technology transfer from military R&D to the civilian commercial high-tech market is used as a starting point. Key people with backgrounds in the military, government, academia and industry have been interviewed. Extracts of these interviews are presented in the report.

Foreword:

Research And Development For Industry And Defense, The Case Of Israel.

The Royal Swedish Academy of Engineering Sciences (IVA) (Kungl. Ingenjörsvetenskapsakademien) is a network of experienced and qualified professionals from a broad range of fields within technology, engineering and economics. Activities are based around fostering contacts between disciplines across national borders with an objective of common development. IVA, established in 1919 is the oldest engineering academy in the world. Its mission is to promote the disciplines of technology, engineering and economics for the benefit of society. In cooperation with business and academic communities, the Academy initiates and promotes measures to strengthen the skill base and competitiveness of the community. IVA is an independent organization, functions as an information and analysis resource to society, contributes to the public debate and advises government and industry in a range of industrial and research and development issues. An important area of interest for IVA when it comes to industrial and technological development is also defense. Historically, defense has been a motor for technological exploration and development. Today, civilian, commercial and military needs are much more mixed as influences for the technological development in society.

IVA has from time to time been active in defense related industrial and technological development issues. A former study discussed the changes in Sweden's defense industries, particularly a move into civilian applications. Changes have been quick and fundamental in many respects during the 1990's. There has been a restructuring and redefinition of the defense industries as well as the concepts of security and national defense. The process started in the USA but has broadened to encompass the rest of the West, Sweden included. IVA's new study is giving more weight to international experiences and the new balance between the civil and military dimensions of technology. An important aspect is the changing civil and defense interfaces.

As part of its present study on research and development for industry and the military, IVA has asked for the present work on Israel: Specifically, the rapid growth of Israel's technology sector and how it relates to defense and other more general policies for science and technology.

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1. Conclusive Introduction

Basic Parameters

Israel has no natural resources to speak of beyond minerals from the Dead Sea. Therefore it has had to rely on the ability of its population to create wealth. Israel is such a small market that it has always had to sell its products to a global marketplace long before “globalization”. Large numbers of Israelis are immigrants with cultural and language connections to their former countries. As a result of the latest wave of immigration from the former Communist Block, Israel has today the highest concentration of engineers of any population in the world. Israel is a meeting place for advanced technologies from parts of the world that until recently were isolated from each other. This diversity has created a potential for innovation and has aided commercial links with a wide range of countries. Israel is the only country with a free trade agreement with the USA as well as the EU and EFTA.

Culture

Israelis admire risk takers and entrepreneurs. This is an aspect of the culture that is deeply embedded. The founding generations of the country, as well as many of the immigrants since then, have lived in an environment where survival was not assured. For these people, the concept of survival was strongly linked to the ability of finding unconventional solutions and to taking personal initiative without waiting for permission from the authorities. Israelis have had to learn to think on their feet, think flexibly and creatively in order to survive and succeed. This has promoted a culture of quick development and small organizations. In Israel, long planning processes and complex organizations tend to lower trust levels among people.

Israel is a thoroughly networked society. Rather than depending on institutions and formal organizational structures, people inside Israel generally operate through personal networks. It is easy to get in contact with people but trust and commitments do not follow automatically. It is usually not sufficient to be affiliated to a trusted organization, people have to prove themselves on the individual level.

Military-Civilian-Academic Crossover

Large numbers of Israeli technology companies have been built on knowledge gained and skills honed by military personnel. Israel made a decision following the 1967 six-day war to develop its own independent arms industry as much as possible so it would not have to rely on other countries. Today Israel is one of the worlds most successful arms exporters and offers some of the most technologically advanced products available anywhere in the world.

There are several contacts between the military, civilian and academic spheres. Some are institutional, like the Talpiot program where young people with special talents receive a high profile military training including an academic education in science and technology. Some military spin-offs (and layoffs) benefit from institutional programs. One example is the incubator program of the OCS (Office of the Chief Scientist of the Ministry of Industry and Trade), that has supported a number of entrepreneurs and engineering teams that formed startups. The incubator program has also served the academic community - the most successful incubators are those working closely

together with academia. The OCS also runs other programs for promoting tech transfer from academia, for example the Magnet program, that supports consortia from industry and the academic world for joint development of generic technologies.

The most important factor today is without doubt the personal networks that have build up during the years. It is the mobility of people that drives the technology transfer.

Military service is compulsory for most of Israel's population. The IDF (Israel Defense Forces) is technologically advanced and large numbers of soldiers are engaged in engineering activities. Many recruits combine service with academic studies – many of these in high-tech fields. Officers in engineering roles are given large amounts of responsibility at an early age and many leave the IDF with a close-knit group of people who they have worked with and understand. These groups often form the core of future engineering groups in the civilian sector. In the Israeli startup and venture capital community, engineering experience from the military is highly regarded. High-tech players in the startup sector often boast about having people from the Talpiot program or advanced defense engineering units in their development teams.

Israel's civilian high-tech industry is strongest in those technologies that have military applications: wireless communications, encryption and data security.

Education

Israel is a highly educated society. The influx of nearly a million mostly highly educated immigrants from the former Soviet Union from the beginning of the 1990s was a boon to the high-tech sector in terms of providing personnel with solid mathematical and engineering backgrounds. Today Israel has a very high ratio of scientists and engineers - 140 per 10,000 inhabitants. For comparison, in the USA the corresponding number is 80, and in Germany it is 60.

Israel has some world-class university departments. Historically, the Technion in Haifa in particular has contributed to Israel's technological capability. Today there are a number of internationally strong universities and institutes that all are of high international standard in areas of applied science and technology: Tel Aviv University, The Hebrew University, Ben Gurion University, Bar Ilan University and the Weizmann Institute. Traditionally there have been very strong links between Israeli universities with leading US universities as well as the research institutes of leading US high-tech companies.

VC Environment

Israel's VC industry was jump-started in 1993 by Yozma, an initiative by the government to match incoming venture capital. In the beginning Yozma invested in other VC funds, matching private funding with an extra 40% of the sum invested. The private investors also received an option to take over Yozma's investment within five years for a nominal value plus an interest rate. In this way, the risk was subsidized for private investors, making them less reluctant to enter a new market with inexperienced management companies. As it turned out, the initiative was successful for all parties. A number of new Israeli management companies were created, attracting large amounts of foreign investment. Israeli high-tech startups received access to an increased number of players in the VC market, and all the private investors used their option of buying out Yozma's shares. The Israeli state had created the worlds second liveliest VC market and got all their money back. The Yozma fund was privatized some years later and continues today as a regular VC fund.

International contacts

Israel is very dependent on international contacts. High-tech is a global business and the local market is small. The build-up of advanced knowledge in academia and commercial businesses calls for close contacts with other countries that are prominent in the global knowledge economy. Furthermore, broad international contacts advance possibilities of building peaceful relations with surrounding countries in the Middle East.

The government and the OCS is interested in creating or participating in international agreements, such as the EU's fifth framework program or similar to those bi-national R&D agreements established with a number of other countries.

Israeli startup companies are interested in added value, e.g. teaming up with international investors and multinational corporations that can connect them to the world market and contribute to the international growth of the company. Israeli companies are known to be strong in developing technology, but less strong in marketing and corporate management.

Today, international investors are gathering in Israel with massive resources and the local VC funds are meeting increased competition. As a result of this competition at home some Israeli VC management companies and investors are developing a deeper interest in investing in other countries, for example Sweden, Finland and Germany.

The high-tech community and the peace process

Peace contributes to the business environment and vice versa. With few exceptions, the high-tech sector in Israel is strongly in favor of the peace initiatives and support them actively, both for business and ideological reasons. That said, most successful business people are careful about not mixing politics and business. In general, integrating politics with business increases risks of time delays, interferences in direct contacts between people within the projects and difficulties in delegating decisions.

Among the Israeli high-tech community in general there is a deep wish that the knowledge economy gain a foothold in the wider Middle East, creating widespread networks of people doing direct business with each other across the region. However, business people will always do business where the conditions are best.

2.1 Interview with Gen. Aharon Beth-Halachmi

Mr. Beth-Halachmi is an Electronics Engineer with M.Sc in Computer Science. During his military service, Mr. Beth-Halachmi became the Chief of Defense Research and Development (Brig. General) and the Director General of the Ministry of Defense. In his post-military career, Mr. Beth-Halachmi is the Chairman of "Silver-Arrow" (an unmanned-air-vehicle project), is a member of the Board of "Elbit Systems" and "El-Op", and allocates most of his time as President of the "Eurofund" Venture Capital Funds, investing in and coaching a large number of high-tech startups.

Qu. How important has the defense system been for the creation of a civilian high-tech industry in Israel?

Beth-Halachmi: The Israeli high-tech industry is inextricably linked to the defense infrastructure. If you look at the people who have created the startup-companies you will see that the big majority have a defense technology background.

Qu. Do the major defense companies play a direct role in creating civilian high-tech companies?

Beth-Halachmi: Civilian high-tech companies have in only a few cases been created by the defense companies themselves. Some got started by using the infrastructure of companies like Rafael and Elbit in order to access very expensive required equipment, for instance a fab. I'm talking about companies in advanced technological fields like optical networking technology that are based on work both from the universities and the defense sector.

But usually, civilian high-tech companies are not founded in the backyard of the defense industries. The ways of working in the defense industry are so different - it does not transfer well to the civilian sector. There are several examples of defense R&D projects that people tried to base civilian companies on, and they failed.

Qu. How about state supported programs for transferring defense industry resources to the civilian industry?

Beth-Halachmi: This is difficult and can take years. The most important thing is to create centers of gravity that will attract people and then let the market work. The government participated in retraining, compensation and pension programs for ex-defense industry staff. Many of the staff involved suffered a lot before they found new positions - there was no immediate panacea. It's important to create conditions for growth in order to be able to absorb people from the defense industry into civilian industry. What else can you do? It is painful but you need to let the market work. You cannot be like a totalitarian country. The process is similar in some ways to what Israel went through when absorbing the immigrants from Russia.

Today, the number of staff employed in the defense industries is dropping significantly - it's a problem for the defense sector. It is very difficult for the defense industries to compete with the salaries and option programs of the civilian high-tech industry. Most defense industries can't offer option programs.

Qu. Is the university system also being impacted adversely by the creation of the civilian high tech sector?

Beth-Halachmi: In Israel today there are entrepreneurs who are looking around the universities and incubators in order to find new business ventures. They approach academics in order to offer them a venture capital partnership. Generally the academics are receptive to the idea. I don't know if the professors here are any better than professors elsewhere, but I do know that academics in other places are not thinking as commercially as their Israeli counterparts are starting to do. In Germany for example academics don't tend to give up on the comfortable conditions they have within academia. I'm planning to go to Germany to visit people who have published interesting work in potentially profitable new high-tech fields.

Currently, some university departments are facing a big problem. Companies funded by the venture capital industry are snapping up the professors in telecommunications, algorithms and optical networking devices, and many teachers and professors in the computer science departments have asked to leave for a "sabbatical". They don't want to leave the university permanently - they want a year or two off in order to develop their own commercial activities. The universities have to grant them sabbaticals. Academia has been left with a shortage of teaching staff. The departments are now considering hiring teachers from the commercial sector - people who are good at what they do and who also are capable of teaching effectively. They will be given an adjunct professorship or something similar and teach one course a week.

Qu. Is part of the problem to do with the fact that Israeli universities have held the intellectual property rights to work carried out by the academic staff?

Beth-Halachmi: Yes, but now the universities are beginning to give up their intellectual property rights that they used to have and they are agreeing here and there to accept a lower percentage of ownership in companies based on research done on campus.

Qu. You've been credited with being instrumental in the setting up of the Talpiot project. What is the underlying rationale of the program?

Beth-Halachmi: It was started when a pair of professors from the Hebrew University in Jerusalem came to me with an idea. They had two hypotheses: Firstly, most inventions in the world have been created by young people aged less than 30, and there seem to be statistics to prove it. Secondly, many inventions were made many years after the technological solution was ready. The main reason for this is probably because the people who had the engineering knowledge and technological skills did not know the requirements or need for whatever the invention might be. So based on these two suppositions, they said, "why don't we select some extremely talented young people and educate them to be future innovators". We discussed many times what "talented" means - it's not just about IQ but also creativity and motivation. Anyway, on the program we educate them very intensively with the necessary know-how - mathematics, physics, general engineering, software, and material science - so that at a very young age they will have the tools. In parallel they are trained in military fields so that they can see what are the requirements.

So now you have people with training and know-how, combined with motivation, and an understanding of military requirements and then you let them choose what they would like to do. It's not just about having good resources it's about the meeting of capabilities with know-how. Allowing them to decide what they want to do is also key. A nice thing about the program is that it generally has not created tension between the participants and other military personnel. I think it continues to be a highly successful project. Most of the work is done in teams of course and so they

also learn to work in a team environment. And these people are still young when they leave the military.

Qu. You had contacts with the Swedish arms industry back in the 80s. From this and your experience from Israel, what advice would you give people in Sweden dealing with technology transfer?

Beth-Halachmi: Well I'm not an expert on the situation there but first of all I'd look on the attitude of the government towards its defense industries. Is there really need for a domestic defense industry? There are some particular fields that countries like to be proficient in such as coding and decoding. Today, I can't see why Sweden needs its own defense industry. Probably the defense industries are needed in the same way as other industries in that they employ people and generate income. In an increasingly global economy it would seem sensible to merge them with other industries in Europe and in the USA. It seems to me that the big USA companies would be interested in talking to the Swedish defense sector if they are not doing so already.

It is no good to produce something that nobody needs. In this case it is better to create a short-term problem and make people unemployed than to keep them employed on a non-economic basis. You can always retrain them to do something else. The fact that you have a venture capital industry and are starting an incubator structure in Sweden will help. People with ideas will be able to leave the defense sector and work with a startup. This calls for putting together teams with three types of people: entrepreneurs, technological people from the defense sector and people from the academic world.

In Sweden you are luckier than us, because in Israel we are successful in only a limited number of fields such as telecommunications, software, electronics. You have a very broad skill base including additional areas such as mechanical engineering and the automotive sector. In a way you have almost everything. These industries can absorb ex-defense staff some of which will not be well suited to the high-tech sector. It is all much easier said than done of course.

2.2 Interview with Azi Hemar

Azi Hemar currently serves as deputy Chief Scientist and Director of International Relations at the Office of the Chief Scientist (OCS) of the Ministry of Trade and Industry. He is the Israeli chief negotiator of several bi-national high-tech agreements. He has worked with the OCS since 1986 in several roles, starting as an expert reviewer of projects in the spheres of aeronautics, computer embedded systems, mechanics and electro-mechanics. He has been active as a diplomat, serving for a period as the Israeli science attaché in West Germany. He also spent many years working at Israel Aircraft Industries working in aircraft design, testing and marketing. Mr. Hemar studied at the Technion and at the Ecole Nationale Supérieure de Aeronautique.

Qu. Firstly, how does the OCS go about measuring its effectiveness?

Hemar: It is a very difficult task. We've done it twice in a systematic way but both studies covered two different periods and multiple changes since then mean that the conclusions are not that relevant for today. Technology and the high tech industry have changed a lot since then. The OCS was formed in 1973 at a time when for all intents and purposes there was practically no civilian R&D being carried out by private industries here in Israel. Industry was based on tech transfer not original R&D work. The government saw its role at that time as to help convert our industry to one based on original R&D. The support program similar to what we have now started around 1984. Later on, things changed including the overall economic situation. For instance up to 1985 we suffered from hyperinflation. Until 1992 inflation was around 18%. Support schemes under these conditions obviously have a very different contribution or effect to schemes under other conditions. The last major assessment that was carried out was for the period of the early mid-1990s.

If you want to try and assess, the approach has to be both quantitative as well as qualitative. For instance, did major successful companies receive help from the OCS? For the most part the answer is yes. However, it is very difficult to say what would have happened had they not received support from us. The record shows that most did get our help at least when they started and were dependent on that support. Most of them ask for it also now. Royalties is another way of measuring success but not a particularly effective one. The aim of our support after all is "risk sharing", developing the country's high tech R&D capability as an economic leverage but not to generate revenue for the government for its own sake. We don't support non-risky product development that is supposed to generate revenue in one year. Rather our approach is to support risky threshold technologies that can be converted into marketable products – it is a market driven approach rather than a technology approach. When I say risky technology I mean advanced technology not straightforward engineering – not only R and not only D!! Support should be given to products that have a good commercial model behind them, with an added value to the national economy.

Qu. Are there other bodies besides the OCS that have had a major impact on the high-tech industry?

Hemar: The only organization that supports industrial R&D in Israel is the OCS. No other organization directly supports the industry that I can think of off hand. However, if you look at it more broadly, the background of staff and researchers is vital. The universities as well as the research carried out in the military are crucial to building the knowledge base of the people who later become either entrepreneurs or engineering staff. It is very important to have a strong educational system and the Israeli educational system is perhaps the most important factor to the industry's success.

In the past, defense research was the major source of advanced technologies. The sales embargo on advanced military systems imposed on Israel created the need for self-developed qualitative weapons. The result was the creation of very strong technological teams and infrastructure. To a lesser extent this is also the situation today.

In Israel everyone comes through military service. Some engineers go to military service after their studies and serve several years. This group has several advantages: They go through officer training. They are trained to lead, to take responsibility, to evaluate risk and take calculated risks. They also get a lot of responsibility as developers – usually software developers. They have significant responsibility and gain project management skills – both in terms of managing teams and in terms of the technology aspects. This is the added value the military gives them. The other factor is that it is easy to form a small close-knit group that understands each other.

Yet another parameter is diversification: We are a small country with a small army. Engineers in the army are working on a wide range of technologies and have a wide range of experience. One day they are working on software and the next day on testing equipment and so on. In the USA and in other countries things work differently. There, people become experts in a specialized field of knowledge and work on it for 5-6 years. This never happens in Israel except in the universities where people work in the vertical way rather than the horizontal – horizontal meaning moving around topics and being able to integrate them. Our approach also has its disadvantages.

Qu. How many companies came directly from the military?

Hemar: It's impossible to even guess. How do you define it? Lots of people are operating complex technological systems and equipment in the army – if these people set up a high-tech company can we really say it was due to their military experience? Another answer would be to say “yes a lot of them” – a large number of Israelis have their first exposure to sophisticated technology in the military.

Qu. The military industries of some countries are having to convert technology to civilian applications – is it happening here too?

Hemar: Yes it is happening but it is not necessarily diversification. Take the Israel Aircraft Industries for example. They work on civil aircraft and service them. However, it is a different division and they continue to work in the military sphere. In the latter you are working according to military specs and military specs testing. In the civilian sector you work according to assessments of what the market needs. In the military sphere you work according to what the generals who are paying you wish to see. Both spheres operate with completely different approaches to product development. To move from one to the other you really have to change your work methods – management and design processes. Military projects have a totally different design cycle. In the military the path from design to manufacture may involve several different companies. Design reviews and schedules are totally different to the civil sector. It is like the difference between a completely private company and a publicly traded company – you have to completely rethink about everything most of what you do.

Qu. How have the Israeli military industries coped?

Hemar: You either have to start new activities. This means taking out groups of people to create new companies, giving them autonomy and developing new management. You can only use those

people who can adapt. Or you do it within your existing company. The problem is deciding who is the main customer, where do you put your best people. It is a totally different way of thinking. The OCS plays a role. We also support commercial military products but only where there is a market demand. They need to show us what the market is and how they are going to sell their product in detail. If they are not able to do that, we are not going to fund them. The same is true in the civilian sector – we expect to see a serious sales plan and some younger entrepreneurs are learning this process for the first time when they meet with the OCS. The OCS forces them to do an A-Z business plan, costs, manufacturing, and distribution. We help them to think commercially.

Qu. It seems that some Israeli companies in the high-tech sector have moved their marketing and other business operations abroad due to a lack of world-class staff here. Is that a fair assessment?

Hemar: Israel is so small that every company is a multinational in terms of markets at least. For both start-ups and military companies starting to sell civilian products, a major problem is that they don't have contacts in civilian markets abroad. They need to build marketing channels. Historically, the OCS did not fund consumer products for two reasons. Firstly these products require specialized professional marketing and distribution channels that are very costly if you build them yourself – you need to link to existing frameworks. Secondly production costs need to be very low and this is a problem in Israel compared to the Far East for example. The OCS wanted to support engineering based products where customers are engineers looking for quality, performance cost-effectiveness rather than cost and product design or consumer appeal. In this respect it is easier for military technology people to convert to this type of civilian product rather than consumer products.

The problem for the military companies producing civilian products is that while they are in this sense like a start-up they have the decision-making processes of a \$100m company and it doesn't work. Here is the first problem. Military companies are used to working with a small number of customers maybe in five countries, maybe twenty customers at most. In the civilian market you have to work with hundreds or thousands of customers.

Another issue they face is that the organizational culture in the military industries is completely different from product specification to marketing. Military industry also pays higher wages partly due to the high security clearance needed and because the work is highly specialized. Lots of former high-ranking military personnel are employed – when your clients are generals, it helps if you know how to deal with them. The military industries are like universities, they contain very educated people, they invest in knowledge and know-how and money for R&D is plentiful. Somebody else is paying.

Qu. Do people stay in the military industries?

Hemar: I stayed in my golden cage for twenty years. It was a boy's club. A lot of my peers stayed. Not just because it is difficult to adjust to the civilian culture but also because the golden cage has benefits – it is a big plus to be responsible for 300 people rather than managing 30 in a start-up where you have to make your own coffee for yourself. And in the former you have top resources – very sophisticated equipment at your disposal.

Qu. Is it a generational thing?

Hemar: Yes. We never said, “We want to make money.” We wanted a bigger salary for sure or to move up a grade in the hierarchy. In my generation people rarely said, “I want to be rich.” Nowadays people want to be a millionaire, and to be independent.

Qu. Will this create a problem for the military, the military industries and the universities?

Hemar: Yes, it already is in a way. Universities are less problematic because there will always be people who want to learn, to explore.. In industry people don't work in order to acquire knowledge, it's like in the military, they work in order to win, some of them want to win money, some of them fame. Having said that, there are some professors and promising researchers who are saying they have had enough – I've done my share of study and research, now and I want to make money too. Medical doctors too.

Qu. In the civilian sector with rapidly advancing technology, how do you deal with planning something that will take two years to produce by which time the market may have completely changed?

Hemar: Companies have to adapt constantly. There is no way to be sure that what you are currently doing is going to be effective in the near future e.g. Orkit, an Israeli company that makes advanced copper phone line modems is having to change its strategy due to changing market conditions. Today, lots of companies are working on optical technologies yet nobody has proved that these networks can work as a cost effective model. ATM used to be a buzzword and its not anymore. The same is true for countless other technologies. However, people who work on these things gain knowledge, they make a living, pay taxes – it's a positive thing.

Qu. Is the impact of the OCS the same today as it was before the venture capital market took off? Has the OCS lost some of its importance as a result?

Hemar: No, venture capital funding goes to a limited number of people and technologies. They only fund people that they like – particular sectors and people they can communicate with. Not everyone is able to communicate effectively with people in the venture capital sub-culture. They give a lot of money to a small number of people; we give smaller amounts of money to lots of people. We help them to create their attractiveness and increase their competitiveness including vis a vis investors.

Qu. What type of international collaboration are Israel companies seeking?

Hemar: They are looking for added value. This usually means market understanding by technology companies that can contribute in a way that enhances the technology of the Israeli company. Israeli companies tend to know their technology and where their market is but they lack knowledge about operating in the marketplace. They are therefore looking for partners with strength in those markets. But these partners need to be able to contribute to the technology too: Perhaps by reducing testing time, or by facilitating certification, or by providing better materials. Israeli companies are not just looking for distributors or people who can sell their products abroad. The OCS certainly don't support simple distribution projects. An example is Gilat that converted a military technology, developed products based around VSAT and started to collaborate with GTE's satellite division. In the end they bought the division from GTE. GTE had added value because they were already in

major markets and because they had technological knowledge to offer. The BIRD foundation is really the expert in the field of collaboration though.

2.3 Interview with Dr. Yossi Vardi

Yossi Vardi gained his PhD from the Technion in electrical engineering and is a member of the Board of Governors of the Hebrew University. He has started a number of companies including Advanced Technology, for a while Israel's largest software house. He currently holds investments and is active in a wide range of technology companies including RUSure, and GuruNet. As founding investor and chairman of Mirabilis/ICQ - an Internet chat program with over 75 million users, Dr Vardi is today a well known personality within the global IT industry. Dr. Vardi served as director general of Israel's Ministry of Development and Ministry of Energy. He was a member of the Advisory Board of the Bank of Israel, the board of directors of the Development Corporation for Israel, the co-founder and Chairman of Israel Chemicals, the Chairman of Israel National Oil Company, and many others. He acted as an advisor to among others the World Bank, the United Nations, the Mexican government, and CEO's of multinational companies, e.g. Occidental Petroleum Corp. Dr. Vardi chaired government-appointed commissions and committees, e.g. the Public Commission for the Regulation of the Electricity Sector and The Public Commission on Raising Venture Capital in the Stock Exchange. During peace negotiations with Jordan he led the economic and regional cooperation negotiations. He also led the oil related negotiations in the Israeli - Egyptian peace talks, participated in the Wye River peace negotiations with Syria, and in the economic discussions with the Palestinians

Qu. The military and universities have often been said to be the underpinnings of Israel's high-tech industry. Do you think this is true?

Vardi: Yes, but it's not just a question of the universities and the military. You have to consider the financial environment and cultural issues too. Without these two broad components in the equation, it does not matter how technologically advanced your military is because the technology will not be transferred.

The internet is very suited to young people. Young users are still the major driving force of the internet. Paradigms being used don't come from books, they are totally new and suitable to young people – more so than any other industry in the history of high-tech. Now you have these young Israelis who have access to this technology in the military and they want to migrate it or at least use their knowledge to develop civilian applications. They have no money or responsibilities and nothing to lose so they are willing to take risks. This is also to do with culture and the tendency of the Jewish people to be entrepreneurial. This tendency was honed through the generations. In other times it took other forms. You should be a lawyer, or a doctor. You have to be independent. The 21st century version is to be an entrepreneur. There is very little to risk. If whatever this young person works on doesn't succeed then OK it doesn't succeed and he or she will go back to being an employee. There is a huge tendency to take the risk because in the case of failure little damage is incurred, both in real terms and more importantly perceived damage. The community in Israel looks at entrepreneurship in a positive light. This is a cultural issue. If it is not part of your culture, it's not going to work this way.

Qu. And what about the financial environment?

Vardi: OK. Now this kid needs money, which doesn't grow on trees as we say. So you need a structure that will give money for these rather insecure and experimental projects. You need the entrepreneurs, you need people who will fund the pre-venture capital phase, and you need venture capitalists, which act as a kind of broker or mediator between money and the entrepreneurs themselves. You need access to local and foreign markets, alliances with foreign venture capital, and you need an exit path which means investment bankers. You need all these pieces in place otherwise it will not work.

Qu. Is this financial side particularly Israeli? Doesn't it exist elsewhere?

Vardi: No, I don't agree with you. Some countries totally lack venture capital actually. Here in Israel the government started a project called Yozma that I was involved with. In 1993 the government said to the somewhat primitive marketplace at the time – if you bring in foreign venture capital, we will co-invest with you. Furthermore, they said, we will offer you a formula in which you can buy back our shares in the companies. Overnight this inspired the development of the local venture capital industry. Yozma was extremely important. So we have the cultural aspects and the financial aspects.

Qu. What else is needed?

Vardi: The next thing you need are some nuclei around which the entrepreneurs will be able to cluster around, to build upon. In the USA it was Stanford, MIT, and companies such as Fairchild. In Israel the main nuclei were the military, and also the Technion in the 1960s and 1970s. This is why the genesis of the high-tech industry was around Haifa.

The other thing you need is coaching or mentoring. The first generation of entrepreneurs provides credibility and knowledge for succeeding generations. So we are talking about a finely balanced network of factors that have to be in place – it is not just about universities and the military.

Qu. Is there anything about mentoring here that is different to what happens elsewhere?

Vardi: No, it exists wherever you have a thriving high-tech industry. Mentors can be serial company builders or venture capitalists. They provide the know-how of succeeding – the chefs if you like.

Qu. How does the OCS fit into it? Has it been effective?

Vardi: The OCS was important in the early stages when capital was not available and now it still plays a role. However, if you closed it today then the industry will continue to thrive. Also in recent years, its role has become more that of supporting businesses in difficulties. Its role has changed even if it is not something they will happily admit.

Qu. In terms of future outlook, is there a risk that this productive network will falter? Are there things that worry you about the future?

Vardi: There will be ups and downs but I don't see any threat to the industry as a whole. On the basis of looking at other countries, our high-tech industry will just be reinforced and strengthened. It will become more experienced, more developed and stronger too. At least according to my humble opinion, which is not so humble by the way!

Qu. Will Israeli companies develop the marketing and management skills that until now they have had to search for abroad?

Vardi: Sitting here catering to remote markets is not an easy task and I think a happy balance was developed - it works. I think we will continue to see a relationship between local technology talents and foreign marketing skills but we are learning the latter too. Slowly but surely a cadre of

experienced marketing people is being developed. Our strength will continue to be in technology though. Its not just technology it is also about ideas and creativity. The spark is what is important.

Qu. What role does a country's tax regime play?

Vardi: It plays a big role; the taxation environment should cater to the needs of the industry. Firstly, the tax structure should make it attractive for companies to stay in the country, and certainly not make it prohibitive to do so. In the global village it is relatively easy for a company to relocate to any number of alternative countries. Secondly, the tax framework of the country shouldn't restrain mergers and acquisition activity or share-trading transactions. The industry is constantly in flux and requires ongoing restructuring. Finally the taxation system should allow staff to be remunerated with options. Otherwise the best brains will not stay in the country.

Qu. How does Israel fare on this level?

Vardi: Israel is a fairly good place in this regard and the government works with the industry in improving the situation.

2.4 Interview with Prof. Jacob Ziv

Jacob Ziv is President of the Israel Academy of Sciences and Humanities and advises the government on areas of the Academy's expertise. Scientifically, he is active at the Technion Electrical Engineering Department, having held a number of senior roles both within the Technion and Israeli academia in general. He has been the dean of the faculty of electrical engineering and vice president for academic affairs. He co-invented the LZ data compression algorithms, the leading world standard method for lossless data compression, making him the "Z" of compression, as in "Zip" and other known implementations. Professor Ziv has been the Head of the Communications Division at the Scientific Department of the Ministry of Defense. He was the Chairman of the Israeli Universities Planning and Grants Committee. He has been through the trials and tribulations of co-founding his own software company. His most celebrated academic work has been in information theory for which he has been awarded a number of international prizes and awards, such as the IEEE Information Theory Group Best Paper Award - for two years running - in 1976 and 1977, the Marconi International Award 1995, the IEEE Richard W. Hamming Medal 1995, the IEEE Information Theory Society Shannon Award for 1997, the ACM 1997 Paris Kanellakis Theory and Practice Award, the 1998 Eduard Rhein Prize for Basic Research, and the IEEE Information Theory Society Golden Jubilee Award for Technical Innovation. He earned his PhD at MIT.

Qu: What is the background to the interaction between the military and civilian spheres in technology development?

Ziv: Historically Israel made a huge investment in human resources towards developing military R&D. It had no choice. The same was true with agriculture, and there has always been a rich interaction between the military, universities and industry in Israel. The foundation of the system was a stream of immigrant scientists who established a tradition of striving for excellence. It is this solid base that underpins today's successes.

Some of the top university engineering departments in the country can be traced back to a group of people who moved from the defense establishment. One example is my department, the electrical engineering department at the Technion. Another is the Technion's aeronautical engineering department that was established even prior to the establishment of the aircraft industry. In the other direction, these departments and others have educated generations of students the best of whom were employed in advanced R&D in special units in the military.

Qu: What is the process by which technology get transferred to the civilian sector?

Ziv: Some people have indeed said that technologies have been transferred from the military into civilian projects but the truth is more complex. There has been a flow in both directions and anyway the flow is in terms of skilled people not the technologies themselves.

To see the impact of the military-civilian link, take a look at where the civilian sector is at its strongest and where it has weaknesses. Take a look at biotechnology where Israeli companies have made almost no impact compared to what is happening in communications and information security technologies for example. That the industries have no involvement in biotech is probably not a coincidence. While there are issues in biotech to do with a need for a significant long term financing commitment, I think the lack of the university-industry link here is significant. After all, Israeli academics have been doing some top work in the life sciences for years so you might expect the situation to be different.

A large part of this military-civilian link revolves around the academic tracks in the IDF. A large number of recruits to compulsory service combine their service with academic study. The army

pays for this study in return for a commitment to remain in the army for a longer period of service than the required minimum. Only the best students are accepted onto these programs. These people make up the bulk of the staff for the R&D work in the military. And they have an enormous impact.

Qu: Presumably these people leave the military...

Ziv: In general there are two groups who make their way into civilian R&D from the military. The first set is those who served for example in the role of project managers at the air force where their responsibilities involved managing equipment and overseeing R&D projects abroad. Their service brought them into contact with major international companies like Boeing for example. Many people in this group have found themselves as managers in large technology companies. The other group are people who carried out advanced R&D in the military. This group is made up of those who generally took their R&D skills and are fueling the start-up sector in Israel. They leave the army not only because the salaries can't compete, although the army is trying to keep up. They also leave because as officers they find themselves in position of managing others and becoming administrators while their real talent and pleasure comes from doing hands-on R&D.

Qu: What about the Talpiot program that has been talked about so much in the Israeli media?

Ziv: Talpiot is la crème de la crème of the academic programs for new soldiers. It is considered "impossible to get into" and the military benefits from this "exclusiveness". Israelis have a weakness for anything that is difficult to get in to. As a result there is no lack of recruits volunteering for special units both the academic ones and others.

However, in my opinion Talpiot is problematic because as a program for very gifted or genius high school graduates it is too restrictive. They do not have the freedom to develop knowledge and skills in the areas that particularly interest them. Instead they all follow the same program and academic structure. People of this caliber should be encouraged to follow their interests. When I've come across them at the Technion following on to Masters programs or beyond they do not seem to be any more impressive than ordinary graduates of the military-academic programs. Other people will definitely disagree with me about my views of this program.

Qu: What effect did the Lavi Project have on Israeli Civilian High-Tech?

Ziv: Some people have said that the cancellation of the project was a major factor in the growth of the high-tech sector here. The argument is that lots of skilled staff were made unemployed and then went to start up their own companies. I don't agree really. I think the effect was marginal. I believe many of them went abroad. For instance many aeronautical and mechanical engineers looked around and then went to South Africa although many of these will have returned by now. Electronic engineers were employable here though – there were jobs available.

Qu: What about the government's Office of the Chief Scientist, what role has it played?

Ziv: Although the Office of the Chief Scientist (OCS) at the Ministry of Trade and Industry has been by far the most successful and received the most publicity, actually each ministry had its own Chief Scientist. The chief scientist in the Ministry of Agriculture is also successful. Others have definitely not been successful to a lesser degree.

Most people think of the incubator projects in connection to the OCS. However, another project that we are involved in is the Magnet Project. It is a great framework for industry-academic collaboration. The linear model in which governments try to be a mediator between industry and universities, telling both what is important, is outdated. This is how the Ministry of Science used to work. It wasn't successful. Government should invest in infrastructure and sometimes support joint initiatives when proposed. With Magnet, the funding is available to companies who can persuade the academic community to collaborate.

Qu: What effect has been the influx of major technology companies on the Israeli high-tech sector?

Ziv: Some people such as Zohar Zisappel of RAD have argued consistently that it is bad for local companies as it draws away the best engineers from local companies and all the benefit goes to foreign multinationals. I think it is a good trend though. Israelis can learn a lot from working in these companies in terms of professional development. What's more is that many of these engineers then leave and start up their own companies taking their skills with them. If you trace where people have been the positive effect is apparent. Anyway, after all what you should care about is people. If you give a chance to good people to develop themselves it is good for the country.

Qu: What are the problems, if any in the military-civilian relationship?

Ziv: One big problem is that increasingly industry is becoming a big black hole both for the IDF and especially the universities. A few years ago the salary gap was not that big when you take into account the fringe benefits the IDF and academia had to offer. Increasingly though the army is finding it hard to compete. Equipment and systems are becoming increasingly complex and require expertise just to maintain them and nobody who could work as an electronic engineer wants to work in maintenance, as it is not interesting enough. Similarly the universities are finding it hard to attract graduates to continue to PhD level and are even losing faculty to the commercial sector.

Qu: How can this be changed?

Ziv: One program we are looking at is to encourage both industry and the military to fund PhDs on a "no-strings attached" basis – say 20 PhDs a year. Staff would undertake a PhD funded by their sponsoring organization at say 60% pay for industry or more from the military. They would be allowed to teach – students from the army are not allowed to teach at the moment. At the end of the PhD some of these people would decide to remain in academia. Others would go back to the army or their companies having developed professionally. This type of program is essential to maintaining a balanced system. The IDF's response was positive but recently it has had to pull out for the time being due to a lack of funding. Beyond this, the model where industry is supporting universities is much less developed than it is in other countries. Incidentally the idea of "giving back" is starting to catch on such that the Israeli branch of Friends of the Technion is now the second biggest donator behind the USA branch.

Qu: How important is good planning?

Ziv: Some people within and outside of the university system today talk about the need to plan ahead for the needs of the economy. However, the university system works under a seven-year cycle more or less. There is not too much point planning that far ahead in my opinion when demands and markets change so quickly. Anyway, increasingly looking at the needs of Israel is less

important than looking at the situation globally. What we need to concentrate on is to give people an excellent grounding in basic science and to foster the ability to adapt to changing circumstances. We are lucky in that we Israelis do not lack the ability to improvise – it is not something that we need to consciously teach. A good scientific grounding together with the fostering of entrepreneurial skills is what is needed.

3. Glossary

Lavi

An Israeli-American joint venture to build a new generation of close-support fighter jet. The project was cancelled after several prototypes were built and flew. The resulting dismissal of large number of engineers has been cited as being a catalyst for the civilian high-tech market in Israel.

Yozma

A venture capital fund and management company established in 1993 by the government but now in private ownership. Invested in both startups, but also in private VC funds on a matching basis with private investors, giving the private investors the option of buying them out from the investment within five years. Widely credited with being the catalyst that got the Israeli venture capital industry going.

Talpiot Project

The Talpiot Project was established in 1979 to increase the military R&D capability of the country. The program selects recruits to the IDF following a tough selection program in which applicants are expected to demonstrate high levels of competence in science and mathematics, high motivation, and the ability to think creatively. Participants serve for an extended period of time. As part of their service they undergo officer training and complete degree studies at the Hebrew University.

Beyond the elite program, the IDF pays for a larger number of talented students to undertake undergraduate studies in return for extended service. Studies are completed prior to service so that the IDF benefits from the accrued knowledge.

The Office of the Chief Scientist (OCS):

The OCS is part of the Ministry of Industry and Trade and has been operating since 1973. The OCS is responsible for implementing government policy regarding support and encouragement of industrial R&D.

The OCS mission includes:

Expansion of the technological and scientific infrastructure of Israeli industry.

The development of science intensive industry.

Improving the competitiveness of Israeli industry

Increasing national industrial production and improving the balance of trade.

R&D Grants are available to companies whose projects have been approved by the Research Committee of the OCS. The grants are a percentage (between 30% and 66%, depending on circumstances) of the estimated R&D expenditure. In cases where the government assisted R&D results in a commercially successful product, the developers must repay the grant through royalties. The MAGNET program allows the encouragement of generic- pre- competitive technological cooperation executed by consortia of industrial companies and academic research institutes. The [Technological Incubator](#) program supports novice entrepreneurs at the earliest stage of technological initiatives and assists them to implement their ideas by turning them into exportable commercial products.

[International cooperation](#) programs - the OCS is responsible for the implementation of the agreements signed by the Government of Israel to actively support and encourage R&D cooperation between Israeli and foreign countries.

Israel Time Line: Some Selected Industrial and Defence Key Dates

1924	Technion University Opens in Haifa
1948	Formal establishment of IDF and War of Independence.
1953	Israel Aircraft Industry established as an autonomous unit of the Ministry of Defense, established to overhaul and maintain planes owned by the Israel Air Force.
1956	Sinai Campaign. Fought to put an end to terrorist incursions into Israel and lifted the Egyptian blockade on Eilat. Operation "Flying Carpet" brings thousands of Jews from Yemen to Israel
1958	RAFAEL founded (Israel Weapons Development Authority)
1964	Motorola Israel established after a presence in the country since 1948. The first division set up outside North America.
1967	Six-day War.
1968-1971	War of Attrition. A period of terrorism, guerrilla warfare and static artillery exchanges, particularly across the Suez Canal.
1973	Yom Kippur War. Surprise Egyptian and Syrian attacks lead to several months of military activity. Office of the Chief Scientist starts operating in the Ministry of Trade and Industry.
1974	Intel opens its first non-USA R&D center in Haifa.
1978	Anwar Sadat pays first visit to Israel by Arab leader
1979	Peace treaty with Egypt. Securing of Israel's southern border and formalization of peace. Talpiot Program started. First Merkava MK1 Battle Tanks delivered to IDF. MK4 is under development.
1980	Launch of the Lavi multi-role combat aircraft program.
1982	Lebanese War. Israel would stay in Lebanon until the year 2000.
1986	Maiden flight of Israel Aircraft Industry's Lavi fighter jet.
1987-	Lavi program cancelled.
1995	Arab uprising (Intifada) in the occupied territories. The goal of the Intifada was to establish a sovereign Palestinian state through an uprising of a large number of residents and terrorist operations within the pre-1967 Israeli borders.
1988	Operation Moses secret airlift brings Ethiopian Jews to Israel. Israel launched the Ofeq (Horizon) 1 test satellite, using the Shavit (Comet) launcher.
1989	Russian Immigration starts. 720,000 immigrants will be absorbed over the next decade. Since 1996 the average number of arrivals is 70,000. The majority of the immigrants have higher education. Israel becomes the country with the highest amount of engineers in the world.
1991	Gulf War. Israel attacked by Iraqi scud missiles. Technological Incubator Program established by the OCS.
1992	Yozma established by the OCS - birth of the modern Israeli venture capital industry
1993	Declaration of Principles with the Palestinians (Oslo Accords).
1994	Peace treaty with Jordan. Formalization and expansion of unofficial relations that had existed between the two countries.
1995	First test flight of the new anti-ballistic missile "Arrow 2."
1996	Intel, decided to build its second production plant in Israel to directly employ 1500 staff. The new plant will supplement the companies R&D centers in the country.

1999 Economic Figures

Inflation	1.3%
Unemployment	8.9%
Imports of Goods	\$ 30.63 b
Export of Goods	\$ 23.55 b

GDP	\$ 98.9 b
Business Sector Production	\$ 66.17 b
GDP/cap	\$ 16,170

VC Activity:

In 1991 there was one VC fund in Israel. Today there are over 100.

In 1992, total foreign investment in Israel stood at \$537 million. For 1999, the figure was approximately \$3.7 billion.

Listed Companies

Today there are over 120 Israeli companies traded on US stock exchanges. More than any other country outside North America.

During 1999, 12 Israeli companies made IPOs on Wall St, raising over \$1.9 billion.

There are over 20 Israeli companies traded on various European exchanges.

Software Industry

During the 1990's, sales of Israeli software have increased 700%.

Professional manpower has increased 250%.

Software exports:

1997	\$1 billion
1998	\$1.5 billion
1999	\$2 billion
2000	\$2.5 billion (projected)

Number of Companies

Today, Israel has about 2,000 high-tech companies and more than 3,000 high-tech startups. These numbers represent the second highest concentration in the world, in absolute terms, after California.

Education

24% of Israel's workforce holds university degrees (ranking 3rd in the world, after US and Holland).

12% hold advanced degrees.

35% of Israelis between the ages of 25-64 hold a university degree.

40% of new immigrants hold academic degrees.

There are approximately 6000 educated engineers in the IDF, with 2000 coming through the degree/service route each year.

Immigrants by Year of Immigration

1948-51	688,000
1952-59	272,000
1960-69	374,000

1970-79	346,000
1980-89	154,000
1990-98	879,500

Immigrants by Continent 1948-1998

Europe	59.0%
Africa	17.6%
Asia	14.6%
America & Oceania	7.7%
Unknown	1.1%

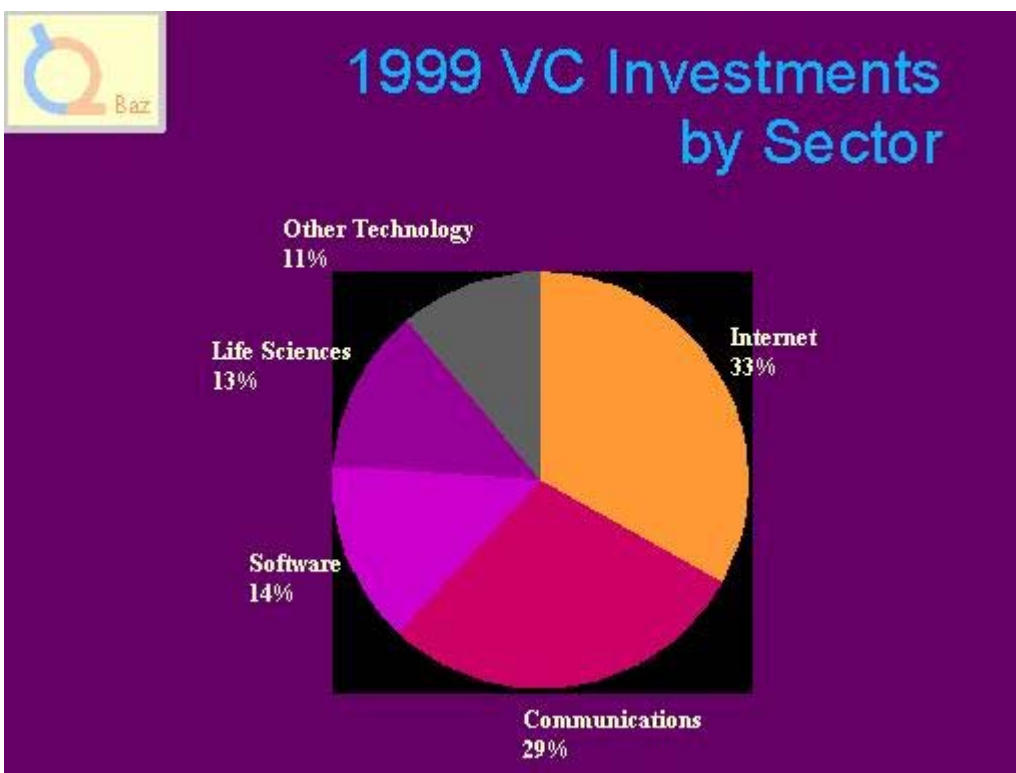
4. Internet Resources

Media	
Globes	www.globes.co.il
Haaretz	www.haaretz.co.il
Israel.Internet.Com	www.israel.internet.com/
The Marker	www.themarker.com/eng/
Jerusalem Post	www.jpost.com www.jpost.com
Official Sites	
Government Portal	www.info.gov.il/
Ministry of Trade and Industry	www.tamas.gov.il/
Office of Chief Scientist Incubator Project	www.incubators.org.il/
MATIMOP Israeli Industry Center for R&D	www2.matimop.org.il/1/index.html
Israel Export Institute	www.export.org.il/IsraelExportInstitute/
Bank of Israel	www.bankisrael.gov.il/
Central Bureau of Statistics	www.cbs.gov.il/engindex.htm
Israel Defence Forces	www.idf.il
Trade Associations	
Israel Venture Association	www.israelventure.com/
Federation of Israeli Chambers of Commerce	www.chamber.israel.net/
Israeli Association of Electronics and Information Industries	www.iaei.org.il
Manufacturers Association	www.industry.org.il www.industry.org.il/
Israel Association of Software Houses	www.iash.org.il
Specific Companies Mentioned	
Elbit	www.elbit.co.il/
Rafael	www.rafael.co.il/
Israel Aircraft Industries	www.iai.co.il
Mirabilis	www.mirabilis.com
Baz Ventures	www.bazventures.com

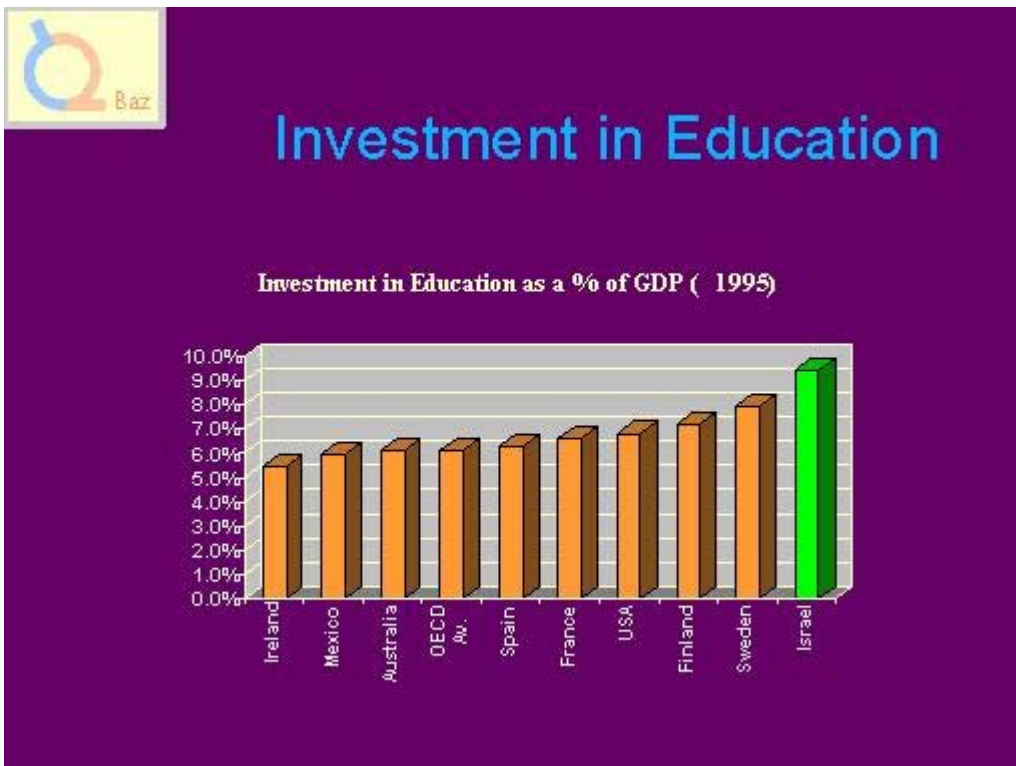
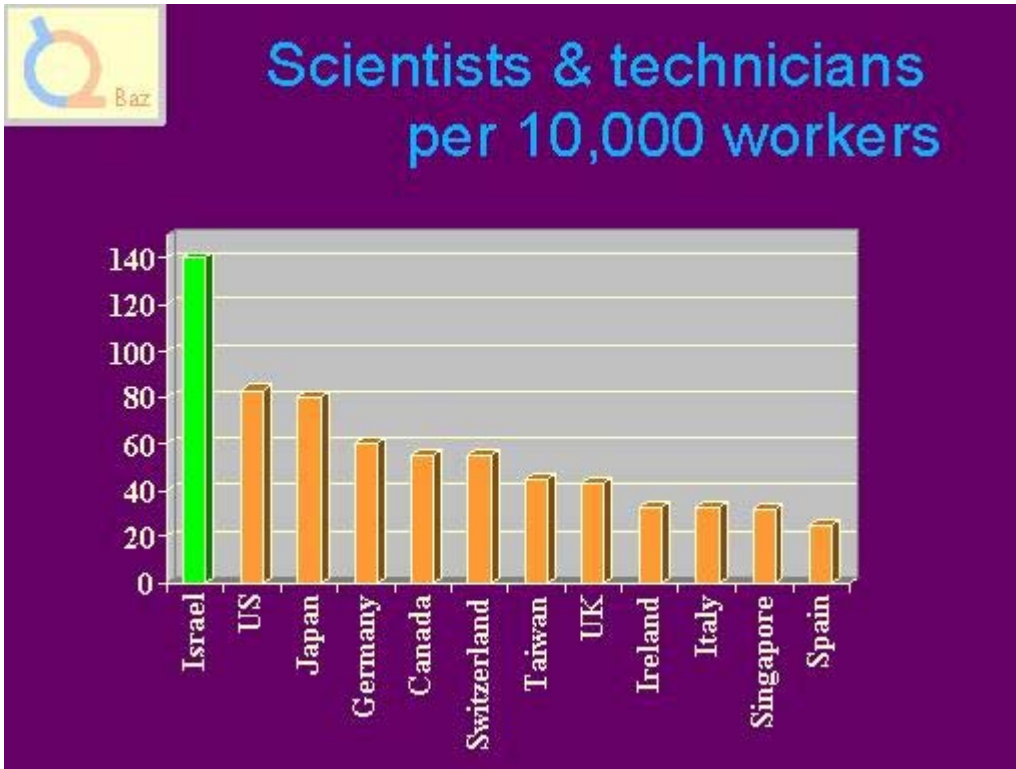
5. Graphs

Source: Israeli Ministry of Industry and Trade









6. ISRAEL - basic facts and overview

Source: CIA World Fact Book, 2000

Introduction

Background: Following World War II, the British withdrew from their mandate of Palestine, and the UN partitioned the area into Arab and Jewish states, an arrangement rejected by the Arabs. Subsequently, the Israelis defeated the Arabs in a series of wars without ending the deep tensions between the two sides. The territories occupied by Israel since the 1967 war are not included in the Israel country profile, unless otherwise noted. In keeping with the framework established at the Madrid Conference in October 1991, bilateral negotiations are being conducted between Israel and Palestinian representatives (from the Israeli-occupied West Bank and Gaza Strip) and Israel and Syria, to achieve a permanent settlement. On 25 April 1982, Israel withdrew from the Sinai pursuant to the 1979 Israel-Egypt Peace Treaty. Outstanding territorial and other disputes with Jordan were resolved in the 26 October 1994 Israel-Jordan Treaty of Peace.

Economy

Economy - overview: Israel has a technologically advanced market economy with substantial government participation. It depends on imports of crude oil, grains, raw materials, and military equipment. Despite limited natural resources, Israel has intensively developed its agricultural and industrial sectors over the past 20 years. Israel is largely self-sufficient in food production except for grains. Diamonds, high-technology equipment, and agricultural products (fruits and vegetables) are leading exports. Israel usually posts sizable current account deficits, which are covered by large transfer payments from abroad and by foreign loans. Roughly half of the government's external debt is owed to the US, which is its major source of economic and military aid. The influx of Jewish immigrants from the former USSR topped 750,000 during the period 1989-99, bringing the population of Israel from the former Soviet Union to 1 million, one-sixth of the total population, and adding scientific and professional expertise of substantial value for the economy's future. The influx, coupled with the opening of new markets at the end of the Cold War, energized Israel's economy, which grew rapidly in the early 1990s. But growth began slowing in 1996 when the government imposed tighter fiscal and monetary policies and the immigration bonus petered out. Those policies brought inflation down to record low levels in 1999 and, coupled with improved prospects for the Middle East peace process, are creating a climate for stronger GDP growth in the year 2000.

GDP: purchasing power parity - \$105.4 billion (1999 est.)

GDP - real growth rate: 2.1% (1999 est.)

GDP - per capita: purchasing power parity - \$18,300 (1999 est.)

GDP - composition by sector: agriculture: 2%, industry: 17%, services: 81% (1997 est.)

Inflation rate (consumer prices): 1.3% (1999 est.)

Labor force: 2.3 million (1997)

Labor force - by occupation: public services 31.2%, manufacturing 20.2%, finance and business 13.1%, commerce 12.8%, construction 7.5%, personal and other services 6.4%, transport, storage, and communications 6.2%, agriculture, forestry, and fishing 2.6% (1996)

Unemployment rate: 9.1% (1999 est.)

Budget: revenues: \$40 billion, expenditures: \$42.4 billion, including capital expenditures of \$NA (2000 est.)

Industrial production growth rate: 5.4% (1996)

Exports: \$23.5 billion (f.o.b., 1999)

Exports - commodities: machinery and equipment, software, cut diamonds, chemicals, textiles and apparel, agricultural products, *Exports - partners*: US 32%, UK, Hong Kong, Benelux, Japan, Netherlands (1997)

Imports: \$30.6 billion (f.o.b., 1999)

Imports - commodities: raw materials, military equipment, investment goods, rough diamonds, fuels, consumer goods, *Imports - partners*: US 19%, Benelux 12%, Germany 9%, UK 8%, Italy 7%, Switzerland 6% (1997)

Military expenditures - dollar figure: \$8.7 billion (FY99)

Military expenditures - percent of GDP: 9.4% (FY99)

Government

Government type: parliamentary democracy

Capital: Jerusalem. note: Israel proclaimed Jerusalem as its capital in 1950, but the US, like nearly all other countries, maintains its Embassy in Tel Aviv

Independence: 14 May 1948 (from League of Nations mandate under British administration)

Executive branch: *chief of state*: President Moshe KATSAV (since 2000), *head of government*: Prime Minister Ehud BARAK (since 6 July 1999), *cabinet*: Cabinet selected by prime minister and approved by the Knesset

Legislative branch: unicameral Knesset or parliament (120 seats; members elected by popular vote to serve four-year terms)

Judicial branch: Supreme Court, appointed for life by the president

International organization participation: BSEC (observer), CCC, CE (observer), CERN (observer), EBRD, ECE, FAO, IADB, IAEA, IBRD, ICAO, ICC, ICFTU, IDA, IFAD, IFC, ILO, IMF, IMO, Inmarsat, Intelsat, Interpol, IOC, IOM, ISO, ITU, OAS (observer), OPCW, OSCE (partner), PCA, UN, UNCTAD, UNESCO, UNHCR, UNIDO, UPU, WHO, WIPO, WMO, WTtoO, WTrO

Geography

Area: total: 20,770 sq km, land: 20,330 sq km, water: 440 sq km

Area - comparative: slightly smaller than New Jersey (Approx the size of Småland / DN note)

Land boundaries: total: 1,006 km, border countries: Egypt 255 km, Gaza Strip 51 km, Jordan 238 km, Lebanon 79 km, Syria 76 km, West Bank 307 km, Coastline: 273 km

Land use: arable land: 17%, permanent crops: 4%, permanent pastures: 7%, forests and woodland: 6%, other: 66% (mainly desert / DN note) (1993 est.)

People

Population: 5,842,454

Ethnic groups: Jewish 80.1%, non-Jewish 19.9% (mostly Arab) (1996 est.)

Population growth rate: 1.67% (2000 est.)

Total fertility rate: 2.6 children born/woman (2000 est.)

Net migration rate: 3.63 migrant(s)/1,000 population (2000 est.)

Life expectancy at birth: 78.57 years

Age structure: 0-14 years: 28%, 15-64 years: 63%, 65 years and over: 9% (2000 est.)

Languages: Hebrew (official), Arabic (for official use within Israel for Arabs), English most commonly used foreign language



Communications

Telephones - main lines in use: 2.8 million (1999)

Telephones - mobile cellular: 2.5 million (1999)

Telephone system: most highly developed system in the Middle East although not the largest
domestic: good system of coaxial cable and microwave radio relay; all systems are digital

international: 3 submarine cables; satellite earth stations - 3 Intelsat (2 Atlantic Ocean and 1 Indian Ocean)

Internet Service Providers (ISPs): 23 (1999)

Transportation

Railways: total: 610 km

Highways: total: 15,965 km (all paved)

Ports and harbors: Ashdod, Ashqelon, Elat (Eilat), Hadera, Haifa, Tel Aviv-Yafo

Airports: 58 (1999 est.) - 33 with paved runways.

Military

Military manpower - military age: 18 years of age

Military manpower - availability: males age 15-49: 1,499,186 , females age 15-49: 1,462,063 (2000 est.)

Military manpower - reaching military age annually: males: 50,348 , females: 47,996 (2000 est.) (Length of military service: Males: 3 years, Females: 2 years / DN note)

7. About the authors

Contact Point:

David Nordfors, Ph.D.

Dr. David Nordfors is a founding partner of Baz Associates and has offices in Sweden and Israel. He has been in contact with Israeli entrepreneurial activities since 1995, following the build-up of the start-up industry. He is a co-founder and steering committee member of the Bluetooth Facility at the High Speed Digital Systems Laboratory at the Technion in Haifa. He has hosted a number of delegations with Swedish business and public sector executives visiting Israel, among them a major delegation from the Royal Swedish Academy of Engineering Sciences headed by Mr Christer Zetterberg. With support from the Swedish government, the Blekinge Institute of Technology and others, he conducted an extended in-depth study of the Israeli Technological incubators and start-up environment. The study generated several bills to the Swedish parliament from major parties suggesting a similar system in Sweden. Dr. Nordfors is the former head of research funding at the Swedish Foundation for Knowledge and Competence Development (the KK Foundation), where he designed and ran programs for funding research in collaboration between universities and commercial enterprises. He was also the initial head of public affairs of the KK Foundation and

developed and implemented models for knowledge dissemination and building intellectual communities. He has been the science editor of *Datateknik*, a major Swedish computer magazine. In 1994 he headed the first conference about the Internet to be held by the Swedish parliament. He was the initial editor of the Internet Societal Task Force ISTF on direct assignment by Vinton G Cerf, initial chairman of the ISTF and co-inventor of the Internet. He completed his doctoral thesis in molecular quantum physics at the Uppsala University in Sweden and was for some years active as a researcher at the Heidelberg University in Germany.

Ben Berger is a psychologist with a masters in industrial psychology. His academic studies were carried out in Manchester and Oxford Universities in the UK and in Haifa, Israel. He set up his own company and worked on numerous research projects for various media organizations and in several Israeli high-tech companies. He served in a research role within the Israeli Air Force.