

January 2002

**COMPANY GROWTH, ACQUISITIONS AND ACCESS TO
COMPLEMENTARY ASSETS IN ISRAEL'S DATA SECURITY
SECTOR**

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*This paper-to be published in *European Planning Studies Vol 10, NO. 8, 2002-* is part of a four-year study of Israel's high tech industry undertaken by the authors jointly with Danny Breznits. The collaboration of: E. Diamant, H. Friedman, U. Savoray, M. Elgarissi, D. Elgarissi, Y. Margalit, Z. Dascalu, I. Mezin, S. On, E. Herscovitz, D. Dor, S. Gruper, R. Nave, S. Touboul, M. Zorea, G. Golan, Y. Cohen, R. Nitzan, and N. Brandman was critical. The present paper owes to Philip Cooke, Elisha Klein, Cristiano Antonelli, Ludovico DiBaggio, Stephen Klepper, Patrick Llerena and an anonymous referees for their help and comments

Abstract

This paper analyses aspects of high tech cluster emergence in Israel during the 90s with a focus on the data security software industry and on strategies of very successful companies dominating such industry. Most of the industry concentrates in Tel Aviv & close-by Hertzliya and to a lesser extent Haifa and Jerusalem. It starts by characterizing the industry as a whole and the Universe of 19 companies comprising it. It then proceeds with an in-depth analysis of the growth trajectories of very successful companies, some of which are listed in NASDAQ or have been acquired by large Multinational Corporations. A 'fast IPO' and a "fast M&A" track have been identified and characterized. The analysis suggests that while Globalization could be beneficial to skill intensive Peripheral Economies like Israel, a significant economic impact may require an appropriate balance between Start Up activity and Downstream Production & Marketing activities

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OBJECTIVES

The first objective is to analyze the emergence and development of very successful companies in Israel's Data Security Sector—an important branch of Israel's Software & IT high Tech Industry. The study will be set in the background of the Data Security Industry as a whole, at it evolved (especially) during the 90s and where a distinction is made between very successful and "other" companies. Very successful companies – 4 out of the 19 comprising the sector towards the end of 1999-comprised more than 90% of the sector's sales, employment and profits. A major distinction in growth profiles of such companies is between those following a "fast IPO track" and those following a "fast M&A track"(Section 3)¹.

The above profiles have a bearing on the question of "Who Benefits From Globalization" in connection with the development of IT high tech sectors in Peripheral Economies. While a full analysis goes beyond the scope of this paper, we here suggests two effects-first, a strong positive stimulus particularly to Start Up (SU) companies, fuelled by the growth of NASDAQ's index and the emergence of a domestic Venture Capital (VC) industry which "mediates" between such companies and Global Capital Markets; and second, a strong process of foreign Acquisition (M&A) of very good domestic companies including SU ones. This last factor raises the issue of the distribution of gains between the peripheral economy on the one hand (Israel in this case) and the acquiring foreign multinationals on the other. The discussion will inevitably involve an analysis of "access" to Complementary Assets (Teece 1986) and of the link between post SU companies (involved in Downstream production and marketing activities) and SU companies (Chesbrough 1999). Section 1 will give Background Conditions, both concerning Israel's Data Security Sector and concerning the broader IT high tech Sector during the 90s. Section 2 will characterize the Israeli Data Security Sector till mid 1999. Section 3 characterizes the Growth Profiles of very successful Data Security companies. We end up with a brief commentary on the impact of globalization on high tech (Section 4).

1. BACKGROUND

The background to the emergence of a successful Data Security sector in Israel (a part of the Software industry) is the process of Globalization of the last two decades of the millenium, the associated surge of high tech industries in many countries, including Peripheral Countries such as Israel; and the emergence in Israel of a new type of High Tech Cluster, one spearheaded by 'product' Software and high tech Communications equipment/software.

1.1 The Growth in High Tech

During the 90s the Israeli economy continued the process of structural change initiated in the seventies (Teubal 1993), but in an accelerated mode(Justman 2000). Within manufacturing (and also Services) we observe a sharp increase in the weight of hi-tech industry. The share of these industries in manufacturing employment increased from 14 % in 1980 to 19.5 % in 1998--a higher share of all or most OECD countries (Avnimelech op. Cit 2000)². The share of IT high tech in total

¹IPO stands for "Initial Public Offering", the first floatation of a company in public capital markets; while M&A stands for "Mergers & Acquisitions" which in most cases here refers to the acquisition of a company by another company.

²The OECD average was 9.9 % in 1996; and that for the US was 11.8%.

manufacturing exports has increased even more dramatically than the share of employment reaching 45% in 1999. A similar picture emerges from recent data on Israel's Information & Communications Technology (ICT) sector (OECD definition) where output increased 4 1/2 fold during the 90s (CBS 2001). Moreover, the share of ICT growth in Israel's Business Sector growth was extremely high - 74 % in the year 2000 and 39% for the decade of the 90s. Finally, a comparison between the share of ICT in Israel's Business Sector compared to the OECD's average (for 1997) shows that Israel's share (13.3 %) was slightly less than double that of the OECD average (7.7%)³.

1.2 A New High Tech Cluster

No less important than the quantitative changes in High Tech are the qualitative ones. Thus the high tech cluster that emerged during the 90s was very different from the military industries dominated cluster of the 80s. It could be termed an "SU intensive High Tech Cluster"(Avnimelech et al in process) or a cluster following closely the Silicon Valley model of High Tech where both SU and VC increasingly play important roles(Teubal 1999). It is also much more integrated and linked with the US and its hi tech clusters in Silicon Valley, Boston area and elsewhere. Thus, the number of SU companies estimated for 1997 was approximately 3000 (Gelvan & Teubal 1997) while the number of VC funds increased from one in 1991 to a number between fifty and one hundred towards the end of the decade (IVA 1997,2000).

The major features of the new High Tech Cluster which emerged in Israel during the 90s, over and beyond the fact that it was overwhelmingly IT oriented, are shown in the Table below

TABLE 1: ISRAEL'S HIGH TECH CLUSTER OF THE 90s-SELECTED STRUCTURAL ELEMENTS

Number of SU:	<i>approx 3000 (1997)</i>
Number of VC Companies:	<i>50-70 (1999)</i>
Funds Raised by VCs:	<i>1500 M\$ (1999) ; 3400 M\$ (2000)</i>
Capital Invested by VCs:	<i>1270 M\$ (2000)</i>
Accumulated No of Offerings (hi tech, NASDAQ):	<i>>>100 (1990s)</i>
Accumulated VC-backed IPOs:	<i>~70 (1990s)</i>
Share of Foreign Sources in Total SU funding:	<i>approx 2/3</i>
Share of I T Exports in Total Manufacturing Exports:	<i>45.7 %(1999)</i>
Mergers and Acquisitions(M&A):	<i>approx. 10 B\$ (2000)⁴</i>

Various Sources

1.3 Factors Explaining High Tech Cluster E

The success of Israel's high tech ICT sector during the 90s would not have been possible without the continued deepening of the globalization process during the last decades of the millenium and of the continued ICT technological revolution. Globalization of technology & knowledge, organizational forms, capital markets, and skills created new opportunities which some countries more than others (or earlier than others) happened to exploit due to their flexibility and capacity to adapt. Israel was one of the first countries out of the US which was fortunate enough to have exploited such opportunities, at least during the 90s. Evidence of this is the fact that

³ Central Bureau of Statistics 2000

⁴According to 'Value of the Exit or of the Transaction'. This high sum also reflects the capital market 'bubble conditions' at the time.

the accumulated number of Israeli IPOs in Nasdaq till 1998 exceeded the accumulated number of all other countries combined excepting US and Canada. Israel ranked third in terms of accumulated IPOs (after the US and Canada) and effectively the first non-North American offshoot of the spreading Silicon Valley 'model' of high tech.⁵

As mentioned, Israel was one of the first countries beyond the US and Canada where the Silicon Valley model (See Saxenian 1998) of high tech has diffused. This was due to a number of factors such as the availability of large numbers of high level technical personnel (the numbers of engineers as a percentage of population is one of the highest worldwide), a pre-existing high tech sector in the 80s with at least moderate success; the establishment and operation of important multinationals in the 70s (Intel, IBM, Motorola, etc); the existence of a set of country specific institutions such as the Army; and strong revealed entrepreneurial capabilities (particularly at the SU phase of company growth, much weaker at subsequent phases). Other countries in Europe and in the Far East are bound to follow suite and reconfigure their existing hi tech clusters (or incorporate Silicon Valley elements into hi tech sectors) e.g. Sweden; Korea, etc. There are a number of mechanisms explaining this diffusion process: 'imitation' & "Learning from Others"; enhanced cross border links; and enhanced selection pressures derived from the successful 'Silicon Valley' model; etc.

Last but not least it must be mentioned that Israeli managers, engineers, entrepreneurs and investors have acquired substantial experience in the US; and that important personal, business and professional networks link such Israeli groups to US counterparts. In the mid eighties there were about 300 Israelis, mostly engineers, living and working in Silicon Valley alone (personal communication). This number has undoubtedly been increased probably by an order of magnitude during the 90s. Saxenian op. Cit has shown that personal and professional links are important factors in the regional dimension of high tech growth. What is special here is the fact that *cross border links & cross border learning* seem to have been critical elements in the growth of the Israeli hi tech cluster in the nineties. Thus Globalization is enabling countries to acquire from abroad some important constitutive components of the emerging new configuration of hi tech.

A list of background factors which explains the emergence of the new cluster plus trigger and reinforcing factors are listed in the box below. An analysis of the process itself goes beyond the possibilities of this paper.⁶

BOX 1: EMERGENCE AND DEVELOPMENT OF ISRAEL'S HIGH TECH CLUSTER: LIST OF EXPLANATORY FACTORS

⁵An additional piece of evidence concerning the last statement was the preference, till 2000, of US Venture Capital companies' non- North American investments of investing in Israel over other countries.

⁶It will appear in Chapter 1 of *Essays in Israeli Hi Tech*, (Avnimelech, Breznitz & Teubal, forthcoming).

EXTERNAL ENVIRONMENT
Diffusion of Silicon Valley's 'model' of IT high tech
Globalization of Asset and Capital Markets
The Ongoing IT high tech Revolution
The Surge of Nasdaq
INTERNAL ENVIRONMENT
A Pre-existing High Tech Sector (Electronics Industry) which was Restructured in the mid 80s
Macro-economic Stabilization (mid 80s) and Economic Liberalization (Trade, Capital Markets, De-regulation of Communications, Privatization)
Onset of the Peace Process (Oslo Agreements)
Government Policies(Horizontal R&D Support 'Backbone' program; and Targeted Program supporting VC industry—Yozma)
Highly Qualified Immigration from the Former Soviet Union (during the 90)
Collective Learning and Co-evolutionary Process generating Cumulativeness

1.4 Stages in the Evolution of the Data Security Industry

The data security area emerged during the third (and present) phase in the development of the computer industry--the Networking Phase of the 1980s. Up until the 80's, using computerized databanks consisted of accessing a central databank (despite appearance of time-sharing architectures and workstations in the late 70s). In the 80's with appearance of the PC the so-called "workstation revolution" began. It involved the emergence of intermediate store sites and the reallocation of the central data base to personal databases ("downsizing"). At this point in time communication networks based on LAN (Local Area Network) technology started developing as well. In the late 80s and early 90's two big changes took place in the world of computers which were related to the interaction of computers and communication. First the appearance of the World Wide Web (and the Internet revolution); and second the use of open systems which were imbedded in modems that enabled connectivity to the outside world. Most of the data security problems emerged due to these changes. Prior mainframe and Unix-based systems were not designed to work as open systems. Moreover having efficient computer systems became important for companies, a strategic factor in their competitiveness. Like all economic assets computers, the data stored in them and their communication lines came under many threats. This together with diffusion of PCs to the population at large is the main reason for growing concern with Data Security.

Stage 1 (1980-1992)

The 80's can be singled out as the beginning of the security field. "The Founders" of this field were anti-virus companies, software protection companies and applications of encryption algorithms in "defined" networks (e.g. within internal networks of large financial institutions).

Anti-virus

They emerged as an answer to the computer viruses that appeared. This phenomenon was started and mastered by young computer hackers who saw this as an act of mischief but as time went on viruses became more harmful. A number of anti virus companies were founded and operated out of Israel. Those companies held a respectable share in this field. A few noteworthy companies were Carmel Software

Engineering, Iris, BRM and Eliashim. The first products that came out were specific anti virus followed by general anti virus and other software protection solutions.

At this stage the security problem was acknowledged and the felt need to provide solutions induced firms to become active in the area. A lot of know how was accumulated during this period, which affected the future development of this field. Anti virus software companies became incubators of future security software entrepreneurs. BRM for example became a Venture Capital fund and entrepreneur greenhouse in the 90s.

Software Protection

The development of the software industry as a leading economic sector intensified the need in preventing illegal duplication of software. As a response the next stage in the security sector development consisted of solutions for protecting software from being illegally copied. Initially this was based on software but quickly it was replaced by hardware based solutions – plugs (dongles). The products are based on encryption and forming a decoding key in a form of software (initially) or a plug (later on). The main company in Israel at this stage is Aladdin.

Encryption Methodologies

Simultaneously, during this period the first leading academics in math and statistics specializing in encryption at Universities became active in the field of encryption technology. A key figure was Dr. Adi Shamir of the Weizmann Institute of Science who in 1977 had co-developed an encryption algorithm RSA (the S stands for Shamir) that was based on a private and a public key. Most of the encryption engines in the world today are based on this algorithm. Some noteworthy companies (some with links to Universities) were founded during this period. They include Algorithmic Research (products based on RSA) and NDS (based on the Adi Shamir algorithm). The products of these companies were mainly applications of encryption technology and their commercialization.

Policy

At this stage of the field's development there were no VC funds in Israel and less awareness of the potential (for Israel) of high tech industry in general and of the Information technology fields in particular. There was no targeted government program for helping technological development of these industries beyond the existing general\ horizontal support of R&D in all industries (with the problem that 'software' was not consistently defined as 'an industrial branch' till later on). The situation started to change during the second half of the 80s, when two important measures were implemented: first. Recognition of "software" as a sector that could benefit from the industrial R&D incentives handled by the Office of the Chief Scientist's "Industrial R&D fund"; and second, promulgation of the 1984 Law which led to significance increases in the subsidies extended to industrial R&D⁷. These changes had an impact on all stages of the development of the Data Security Industry.
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⁷The 1984 R&D Law (apparently) assured R&D grants at a rate of 50% to every project satisfying 'minimum criteria'. These were not 'competitive funds' but incentives that could be more or less relied upon when writing a business plan to be presented to external investors or Venture Capitalists.

⁸Despite existence of one Venture Capital Fund--Athena- this period belongs to the "pre-VC industry" phase(the flourishing of VC in Israel is a phenomenon of the 90s).

Stage 2 (1992-1996)

This stage (1990-1996) is the outcome of two processes-in Israel, an incubation period for technology and entrepreneurs in the Army; and worldwide, popularization of the Internet. This happened within a background where the security problem intensified with the beginning of computer communications within big organizations and once communications expanded beyond the physical restraints of one building.

At this point the main incubator for human resource and learning in this field in Israel was the IDF's (Israel Defense Forces--the "Army") communication and intelligence units. The special nature of the army, being a big and spread -out organization entailed two main, data security- related needs: to communicate information on a real time basis; and to secure this information. Personnel in these units were accumulating valuable experience , ideas and technology , including those pertaining to a product(firewall) which played an important role in the future of the industry both at home and abroad. The Army then was years ahead of the civilian market in the information security field.

All of this meant that towards the end of the eighties a) some of the basic ideas and technology for the whole information security field developed; b) Israel developed a measure of competitive advantage due to two factors: the Army and Academia. As mentioned the Army was not only a source of ideas but also a source of entrepreneurs and skilled personnel (e.g. army veterans who worked in these fields during there army service). The companies that will be created a few years later by individuals having worked in the computer or other units of the Army developed without strong links with the companies founded by people from Academia.

This second stage in the development of the data security segment started in the early 90s with the development of the Internet. The development of the Internet proceeded in steps: initially the Net was used by academic institutes; and only after that the use spread first to big organizations and subsequently to the public at large(currently a more advanced E-commerce stage is taking off). The main changes that took place in the Internet age were in the volume of communications and in a new set of business and technological opportunities. This induced entry into the area of existing companies and entry of completely new ones. The most outstanding company is Checkpoint, which, according to well-founded opinions, basically defined that market in its present form: it both redefined needs (they had changed due to the Internet) and created the demand in the market. At this point other companies entered, the most important of these being Memco. Also some of the companies that existed before the Internet changed the strategies to fit the Internet age (Aladdin being the major one).

During 93-96, the would-be industry leaders five years beyond got established and consolidated. Moreover, a new wave of Israeli companies tried to apply their experience and knowledge in order to secure a leading position in the growing security field. Israel became a leading force internationally in the field of information security, a fact that helped other Israeli companies trying to join this field.

Stage 3 (1996-1998)

An important development in the Internet age was development of programming languages like JAVA and ActiveX. This development created new threats and therefore a need for new security technology and concepts .A result of this is a new wave of companies that emerged in '96-'97 (the third stage in the industry):

Abirnet, Finjan, Netguard, Vanguard, Eagle Eye, Security7. A newer (and latest wave) of companies linked to e-commerce is currently taking off.

Policy and Venture Capital (Stages 2 & 3)

Since the early 90s changes in the VC sector took place following the "Yozma" committee that resulted in the creation of a Government-owned VC fund (with the same name) which is credited with triggering development of the VC industry in Israel during this decade. In less than 8 years the number of VC funds rose from 1 to more than 70. This opened up new sources of finance for hi tech including for data security companies which could now choose among various alternative sources of finance (VC s of various kinds, private and strategic investors, foreign companies and financial institutions, Office of the Chief Scientist Grants, etc). These changes in the business sector "Support Structure" had a strong effect on high tech industry in general and on the Data Security sector. They stimulated the creation of a new wave of SU companies; and indirectly were factors in the emergence of post SU companies, some of which were quite successful.

2. THE UNIVERSE OF "DATA SECURITY" COMPANIES

2.1 The Sample and its Characteristics

Our sample includes 19 companies founded in the following Stages: the *Early* stage A (1980-1990)-- four (4) companies; the *Middle* stage B (1990-1996)--seven (7) companies; or the *Mature* stage C (1996-1998)--eight (8) companies (see Table). The sample pretty well covers all of the Data Security sectors of Israel, that is, we believe that rather than being a 'representative' sample it approximates the Universe as a whole. We say this despite the fact that there is no uniformly accepted way of defining the term "security" e.g. does it include Conditional Access to Pay TV? Our approach was to consider a broad definition of the area and our perception of what the area consists of gradually expanded throughout implementation of the study. For our purposes "security" included at least one of the following: implementing encryption algorithms in any kind of application; software or hardware-based defense of individual computers or computer networks.⁹

Variables and Data

We interviewed each one of the 19 companies during 1999, and the latest information collected does not go beyond mid/late 1999. Our interviews were also complemented by a Survey of all companies for Quantitative Data. The information collected referred to: Company foundation date , Background of Founders/Entrepreneurs;

⁹There was no formal "roster" of "data security" companies, which could serve as the universe from which we could have sampled our companies. In "The Israeli Hi Tech Guide for the Year 1999 " there are 16 companies under the category "Security" a number of which are advisory\consultants companies rather than hi-tech start up companies. Moreover, some of the most important companies in the field were classified as "Software Companies" rather than "Security" companies. After our 'search' led to the identification of the 19 companies in our sample we thought that they would comprise the whole universe. Then our interviewing began. However, after six months of intensive interviewing, a number of additional companies were identified which might be considered as being active in Data Security, some of them recently founded. These were not covered in this project. Thus while we cannot be sure that we covered the whole Universe of Data Security (even as it was in mid 1999) we did include the most important companies which are market leaders in their field (see successful companies in the next section).

Products & Product Families; Company Status-- *Initial* (independent, linked to existing domestic company¹⁰, or incubator) and *Actual Company Status* (independent, public, foreign subsidiary, linked to domestic company, incubator and closed); Initial Financing (Venture Capital, Strategic Partner, Backed by an Existing Company, Bootstrapping, Office of the Chief Scientist); VC involvement; Location (city, area); Mergers & Acquisitions; whether or not an IPO and in what market; Sales, Employment, Employment of University Graduates, Profits and Exports (last full year and rates of growth); and Market Capitalization. This information is incomplete (especially sales information- a sensitive figure for many SU companies); and Market Value, since only four companies underwent an IPO. Moreover in many the limited time for interviews did not enable full coverage of all or even most variables.

Initial(IS) and Final (FS) Company Status

1. *Initial Status:* the dominant shares of companies --(14) out of (19)--- were founded as *independent companies*. The others originated either as SU “linked to (incumbent) domestic companies” (3) -including being domestic subsidiaries or a separate team integrated within such companies; or Incubators (2) -who partner with SU located within their premises.
2. *Final Status:* the distribution of companies according to Final Status (mid 1999) includes a *lower share of Independent companies* -(8) from a level of (14)- and a *higher share of foreign subsidiaries-* (6) up from nil (Initial Status). Four (4) companies undertook IPOs of which (2) remained as *public companies* and another (2) became subsidiaries of foreign multinationals (or foreign companies). (2) Out of the three remaining nineteen companies were ‘linked to domestic companies’ and the remaining one failed and closed. No Data Security companies remained in Incubators.
3. *Links between Final and Initial Status:* Most (6 out of 8) of the companies who where independent and most (5 out of 6) who were foreign subsidiaries in mid 1999 were independent companies when founded. Of the original (14) independent companies--- (6) were acquired by others (4 foreign, 2 domestic); (2) undertook IPOs in NASDAQ and became indigenous public companies; and (6) remained independent.

Acquisitions and Mergers(M&A)

1. *Foreign Acquisitions:* Four (4) companies (Memco, NDS and two others) were *directly* purchased by foreign companies and the domestic parent of two (2) additional companies (who upon foundation were ‘linked to domestic companies’) were also so purchased. This makes a total of six (6) foreign acquisitions out of a universe of (19) companies-about 30% of all companies.
2. The qualitative picture is even more extreme. If we classify companies into Very Successful, (Moderately)Successful and "Others" (see 2.2 below)- we see that:
 - Two (2) out of four (4) Very Successful Companies were acquired by Foreign Multinationals
 - Four (4) out of six (6) Moderately Successful Companies were acquired by foreign multinationals.

¹⁰Part of expected diversification efforts of incumbent companies, mostly in the Software area.

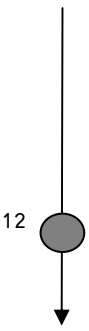
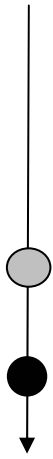
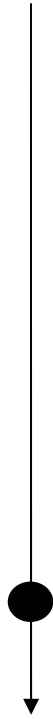
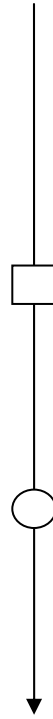
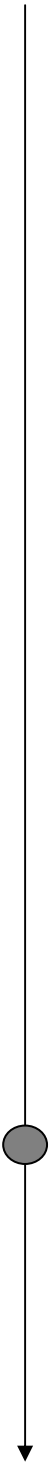
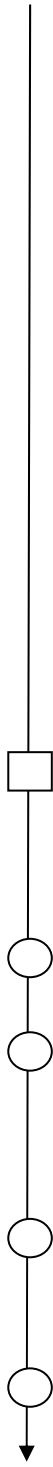
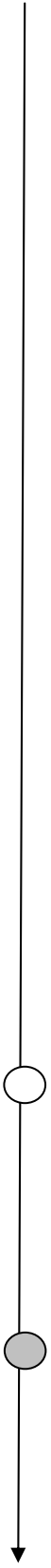
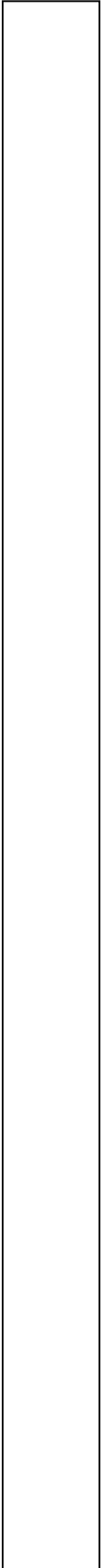
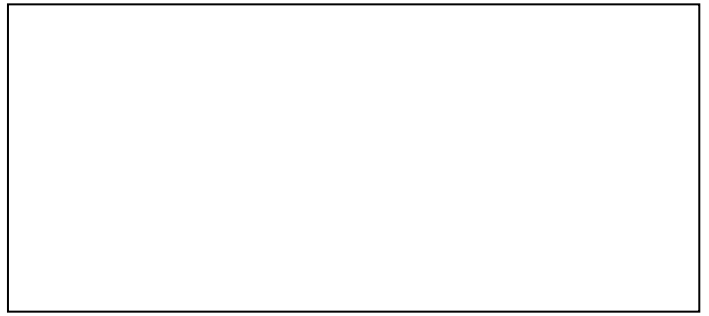
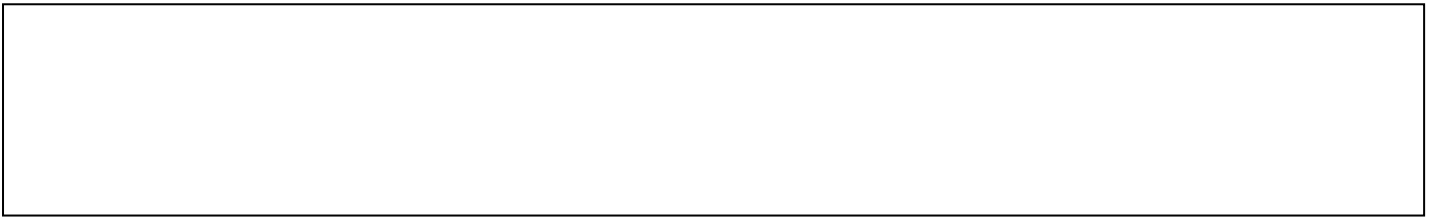
Thus 60% of the Successful & Very Successful Data Security Companies were acquired by foreign multinationals. This however *does not* include CheckPoint, the most important of all.

Table 2 shows in detail the process of M&A within Israel's Data Security Industry (including acquisitions of Israeli companies by both Israeli and Foreign companies [M&A1]; and acquisitions of foreign companies by Israeli companies [M&A2])

TABLE 2: FOREIGN ACQUISITIONS (M&A1) OF SUCCESSFUL ISRAELI DATA SECURITY COMPANIES

<i>DIRECT ACQUISITION</i>		
Company(Performance Category)	Acquiring Company	Year
NDS (SS)	News Group	1991
Memco (SS)	Computer Associates(CA)	1999
Algorhythmic Research (S)	Cylink	1996
Security 7 (S)	Computer Associates	1999
<i>INDIRECT ACQUISITION*</i>		
Company	Domestic Company	Foreign Company
Abirnet (s)	Memco	Computer Associates
Eagle Eye (s)	The New Dimension	BMC

*There are two possibilities-acquisition by an Israeli company (M&A2) first, with the latter being subsequently acquired by a foreign company(M&A1); or acquisition of parent company by a foreign company(M&A1)



*Employment, Sales and Market Capitalization*¹¹

Aggregate employment of 14 (out of the 19) companies was 1816 employees in 1998; aggregate sales for 14 companies during 1998 amounted to 406M\$ (sales data of two companies are 1997 figures); and estimated market capitalization of the group for October 1999 surpassed 6500 M\$¹². There are problems with the aggregate data reported here: the employment figures reported by companies generally include employees in their foreign subsidiaries, not only domestic employment levels. Market capitalization values make use of different data sources (since only three companies are publicly traded companies- four including NDS who went public only after being acquired) and refer to different periods, depending on the date of a M&A or the date of a Venture Capital investment in the company. The overwhelming share of market capitalization corresponds to companies who were founded during stage 2 (1992-1996)¹³ of the Data Security industry of this country. More than 80% of this value corresponds to one company-CheckPoint. Its foundation date coincides with the period when the Internet 'took off'.

2.2 Performance: Categories and Distribution of Firms

Throughout we consider three groups of companies according to Performance: Very Successful (SS--4 companies: CheckPoint, Memco, NDS and Aladdin); Moderately Successful (S-6 companies); and Other (O-9 companies). The O- category includes Failures (2 companies); Struggling (3 companies); and young companies with potential-"Emerging" (4 companies). Table 3 shows the distribution of firms according to industry phase foundation date and performance.

Very Successful Companies are successful in terms of at least two of three indicators: sales -several tens of millions of dollars; market capitalization¹⁴-several hundred million dollars; and high market share in well-established, non-niche markets. There are four companies in this group: Check Point, Memco, Aladdin and NDS. In three of them (all except Memco) all three conditions are fulfilled(that the SS group is small is not surprising given the dynamism of the field). Note that the most successful, Check Point, is a relatively young company--it was only established in 1993. Company value in the Very Successful company group is usually expressed in

¹¹ We have information about *rates* of growth of employment and sales for some individual companies. Data on sales is a sensitive piece of information for non-public companies(this is the reason it is not reported here even in cases were we have the information).

¹² At the time of preparing the first draft (August 2000) the Market Capitalization value is at least double this level due to the continued growth of value of shares of existing companies (especially CheckPoint) and due to the public offering, towards the end of 1999, of 10% of NDS's shares. Sales today are also much larger than 2-3 years ago-CheckPoint's alone are expected to reach the 600 M\$ mark during 2001.

¹³This would include Memco (see below) if we consider that during the two first years of activity it was involved in Security services rather than in security products/software.

¹⁴Despite conceptual and measurement problems "Market Capitalization" should be considered as an important indicator of company performance nowadays, particularly in relation to hi-tech companies. This because current sales and profits alone may underestimate the potential contribution of a company to the national economy. For example, a company with little sales and negative profits may, through an IPO or an M&A bring hundreds of millions of dollars to the country. Having said that it is clear to us that the traditional distinction among economists between the private and the social profitability is particularly relevant here although its identification and measurement in a globalized world could turn out to be extremely difficult. Thus the hundreds of millions of dollars may accrue to a small number of entrepreneurs, managers or engineers who might not funnel them to the economy at all. Some may even be residing abroad.

terms of the value of shares in the stock market (the first three launched IPOs in Nasdaq) or the value of the company at time of acquisition (the case of Memco or NDS).¹⁵

Stage	SS	S	O
A: Early	2	2	
B: Middle	2	2	3
C: Growth		2	6
Total	4	6	9

Moderately Successful companies include companies where sales have either already achieved at least 5 M\$; and/or whose company value is in the tens rather than in the hundreds of millions of dollars. Since there are no cases of IPO in this group, company value assessment reflects either an M&A or the valuation incidental to a Venture Capital investment. In three cases both the sales and the valuation conditions were fulfilled; in two cases- only the company valuation condition has been fulfilled; and in the remaining cases only the sales conditions holds. This group includes two relatively "older" companies (both of which were founded in the eighties) and four companies who were founded in 1993,1994, and 1996(2 cases).

The *Other* category of companies is an heterogeneous group where six (6) out of the (9) companies are "young" in the sense that they were founded in *Stage C* of the evolution of Data Security (the remaining three were founded *Stage B*). Clear "failures" can be found in two cases-a company founded in 1997 who closed; and another founded in 1995 who has been in crisis during the last years. "Emerging" companies are usually young (1996-two companies, 1997, and 1998) that have revealed certain potential e.g. a company with very little sales nowadays but having received an important multi-year sales order. "Struggling" companies lie somewhat in the middle.

2.3 Summaries of Major Companies¹⁶

Summaries of the four Very Successful (SS) companies follow.

Checkpoint

Gil Shwed, Shlomo Kramer and Marius Necht founded Checkpoint in 1993. In the seed stage BRM(an anti-virus turned VC company) invested 400K\$ in exchange for 50 % of the company's stock. In addition to the cash investment BRM aided Checkpoint with building and implementing its business plan. The idea and technology for **firewalls** were shaped in Gil's and Marius's minds during their service in the IDF (Israel Defense Forces--the "Army" in this report) in the late 80s. They waited till the Internet was ripe enough for widespread application not only within Universities but also in businesses. Most of Checkpoint's initial employees were friends of the founders from their army service. In 1993 with the founding of the c, the information security field was acknowledged as a separately identifiable sector. The firm's strategy was to become a leading force in all aspects of information

¹⁵A public offering during November 1999 of 10 % of NDS's shares implied a company valuation of over 1 billion US dollars.

¹⁶Updated till mid 99 approximately.

security but not to move into other fields. In order to implement this strategy Checkpoint established OPSEC – an Interface Standards Committee which includes today over 200 member companies. Control of OPSEC enables the company to be always plugged in into the latest developments in the market. Most of the company's sales are done either by OEM or distributors (over 1000 distributors worldwide)¹⁷. Checkpoint's first OEM was signed with Sun Microsystems, this OEM was of critical importance for checkpoint's sales and for establishing a strong brand name. Checkpoint's strategy did not involve (till lately when its first acquisition took place) buying other companies; it rather used strategic agreements with leading companies. CheckPoint has had a decisive influence on the information security sector in general and on Israeli companies in this area. The influence on Israeli companies has been felt in different ways. First, the company marked Israel as a leading force in the world of information security, a fact that has drawn the attention of foreign investors and clients thereby helping other Israeli firms get market recognition. Second, Checkpoint has proven that it is possible to be an Israeli company and still be a dominating force in its market.

Since its foundation Checkpoint has show amazing progress. Sales amounted to 9.5 million dollars in 1995, 32 million dollars in 1996, 83 million in 97, 142 million dollars in 98 and expected sales of over 200 million dollars for 99.¹⁸ Checkpoint has gone public in 96 with a market value of 500 million and by 10/99 it grew to 4.8 billion dollars. It employed then 560 employees.

Memco

Memco-- one of the first Data Security Companies in the world.- was founded in 1990 by Israel Mezin and Eli Mashlach They began by offering "security" consulting services to companies and by developing their first security product(for servers) which started selling in 1994. In 1996 the company created a Business Development department in charge of identifying candidates for acquisition in Israel and abroad and it signed a strategic agreement with Platinum, a US software company. In 1998 Memco made two acquisitions- NIT (US) and the Abirnet (Israel). It was then acquired by Platinum who in turn was acquired by Computer Associates (CA-company evaluation of 570 M\$). The former R&D operation of Memco is an R&D center of CA's Security Division. In addition to performing R&D it coordinated (at least till 10/99) all of the "security" resources of CA. In August 1999 the first outcome of this effort came to fruition-a product called eTrust which combines the technology from the former Memco, Security 7 and Iris AntiVirus (three Israeli companies purchased by CA during 1999). The position of the former Memco in CA's organization is indicative of the important role played by that company in the world information security market as well as of its capabilities in 1999.

Memco's strategy during the last three years--which combined strong internal growth, M&A and good PR-- was singled out in some of our interviews as their 'model' for growth and exit.

Aladdin

Aladdin was founded in 1985 by Yanki Marglit with a 10,000 \$ investment. The firm provided a hardware solution to software security/protection. Sales and profits were from the beginning important sources of funds(bootstrapping). It gained a respectable

¹⁷In the last 2-3 years the company has eliminated its prior dependence on Sun and has increased significantly its Direct Sales Efforts worldwide.

¹⁸Sales (Profits) for the year 2001 are expected to be 600 M\$ (200 M\$) approximately.

share of this market niche in Europe (sales in the US only began during the 90s). Sales have risen consistently and reached 12 million dollars in 1993. In 1993 the firm underwent an IPO in NASDAQ. In 1995, in order to strengthen its position in the software security market it purchased the technology developed by Elyashim. Sales in 1996 reached 30 million dollars, at which point the firm acquired (or merged with) its German competitor (FAST)¹⁹. By 1998 the firm realized that in order to stay ahead they must adapt their product to protect software on the Internet. This led it to enter the content control field. It then purchased Elyashim and the latter's US subsidiary--eSafe.

Aladdin had an important influence on the information security field before the Internet age and was one of the first player to enter the niche of software protection. It is a successful example of firm adaptation to the Internet-driven changes in the information security market. It is the second most important supplier in the software protection market today.

NDS

NDS was established in 1988 by a group of ten people from the Weizmann Institute of Science. The leaders of this group were Doctor Abraham Peled and Rafi Kesten. The technology of the group was based on the algorithms developed by Professor Adi Shamir in the 80's, who was a consultant to the group but not an associate in the firm.

The firm focused on data encryption (coding and uncoding) for satellite and "cable" communication; and specialized in products for TV broadcasting and conditional access to Pay TV by customers. By 1990 the company already had a complete product, which was a solution to TV broadcasting. A year after the company was acquired by the News Group, which was its main customer (thereby becoming a subsidiary of a foreign company).

The main business areas were already broader in 1999: "to provide the leading systems of the management control and broadcast distribution of entertainment and information to TVs and PCs. The company is well known for the excellence of its products and for its technological capabilities. Its continued growth in sales, profits and in domestic employment (a trend that continued after the acquisition) makes it one of the largest firms in the data security field in Israel and one of the main in its field worldwide.

2.4 Remarks on Foreign Acquisitions

The Data Security Industry shows a very active process of acquisition of good companies by foreign multinationals. This reflects the depth of the process of globalization in ICT and the strong external links of Israel's high tech cluster. Three issues immediately arise. The first concerns feasibility that 'very good companies' in Peripheral Economies, active in ICT areas of great dynamism, achieve rapid growth while keeping their independence²⁰. The second concerns the propensity of such companies to be acquired and the factors --both within the firm and of the external environment- explaining this propensity. The third issue concerns the 'Differential Impact' of successful companies which remain indigenous compared to successful companies which are being acquired by foreign companies. The second, and the some

¹⁹This very successful merger was documented in a case study of the Harvard Business School.

²⁰ Very dynamic areas involving network products might give advantages to large companies like Cisco which could offer both Security solutions **integrated into** Network hardware & software.

extent the first, issue will be discussed in Section 3. A systematic discussion of the last issue will be done in future work.

3. PATTERNS OF GROWTH OF VERY SUCCESSFUL COMPANIES

We focus on the *growth profiles* of the four very successful (SS) companies—CheckPoint, Aladdin, NDS and Memco- which, as mentioned, comprise an enormous share of the activity of Data Security firms in Israel.

3.1 Defining “Company Growth Profile”

The two groups of variables defining Company Growth Profile for our SS companies are *Phases of Company Growth* and *Company Events*. We distinguish these from the variables explaining Company Growth Profile: background of entrepreneur and company strategy; and at another level--cluster related variables and policy. This paper focuses on defining Company Growth Profile, and for lack of space, only scant reference will be made to explanatory variables. For example the analysis of the background of entrepreneurs/founders, will not be reported here;²¹ and only brief reference will be made to the overall context within which firms operate. Thus there are a number of effects of the high tech cluster as a whole on company behavior or company events that will be only referred to in a superficial manner e.g. the fact that some entrepreneurs were active in the Army or in incumbent high tech companies. Also only brief reference will be made as to whether Venture Capital existed at the time(a key featur of high tech clusters) and if it did how did affect the phases, strategy and internationalization events of companies after foundation.²²

*Phases of Company Growth*²³

There are three 'basic' Phases—SU/Product Development (Phase 1), Market Penetration & Broadening of Product Line (Phase2), and Consolidation (Phase 3)²⁴. Every start up company starts with product development, which comprises the bulk of the effort in its initial phase. This stage also comprises initial marketing and it may also include the first orders for the product of the company and, in the case of successful companies, it will frequently include an agreement with a major customer or vendor. At some stage a significant shift in the effort of the firm is recorded in the direction of (main) Market Penetration while, certainly in the case of very successful companies, initiating development of new products (advanced versions of existing

²¹ An analysis of the background of founders of 14 out of the 19 companies (rather than of the four SS companies) will be reported separately.

²²Thus for example, Aladdin did not make use of Venture Capital in its SU phase probably because VC was not available at the time (*Early Stage* of Israel's Data Security industry)in Israel; whereas Check Point and Memco did make use of VC (VC was becoming available in the subsequent *Growth Stage B*).

²³The phases of company growth proposed below differ from those proposed in the literature dealing with Venture Capital Our classification emphasizes the functional aspects such as R&D, Marketing etc whereas the classification used by VC emphasizes more administrative and especially financial aspects. We are also interested in phases of growth beyond the 'exiting' of VC-backed companies.

²⁴Phases 2 & 3 are post SU phases.

products and other related products). This is Phase 2. The "Consolidation Phase"²⁵ (Phase 3) of very successful companies generally involves a much clearer and defined focus for the company and a strategy which is much more explicit and detailed; a clear organizational and managerial set up including the manning of important senior managerial positions e.g. VP for Business Development etc; reduction of certain elements of uncertainty about the future and even more important a certain capacity to predict a reduction in the future "financial" performance of the company; and given disappointing results, rapid restructuring of the company. In parallel to all of this, the consolidation phase would tend to show a certain "balance" between technological and market\marketing efforts; and greater stability of rates of growth of sales (less variation, but still high at least for a time).²⁶ Our intent here is to associate the above sequence with an "indigenous" growth profile of Israeli companies. Whenever a foreign company acquires an Israeli company it enters a Post-Acquisition Phase. The Post-Acquisition Phase may begin at any one of the three phases of "indigenous" growth.

The Consolidation Phase of a company may involve two possibilities (see Figure): *Indigenous Consolidation* or *Acquisition by a Foreign company*. Acquisition by a foreign company is an extreme version of (or adaptation to) globalization one in which the domestic company may lose its identity. The alternative indigenous consolidation involves moving upwards and in a balanced way in terms of accumulated assets pertaining to technology, marketing\customers, and other tangibles and intangibles--while maintaining the essential Israeli identity. For example CheckPoint has shifted from almost exclusive reliance on an OEM agreement with Sun to a diversified portfolio of distributors, VAR's and Direct Sales.

Company Events

These include -- *first major marketing\sale agreement, IPO, acquisitions by a foreign company(M&A1), domestic company acquisitions of(or mergers with) other companies(M&A2); Marketing Strategy & Target Customers; and the Accumulation of Marketing\Market & Customer-related Assets*. Many of these are 'internationalization events' that is they involves activities, contractual arrangements and transactions with foreign agents and organizations. Company events may be strongly affected by Company Strategy e.g. whether or not a major objective of founders and investors is to foster a large indigenous company or to develop a company for selling.

The issue of asset accumulation seems to be critical since, Israeli companies frequently start with a technological idea and are characterized by a severe imbalance initially both in their outlook-- which is frequently 'technology push' rather than 'demand pull'; and also in the pattern of accumulation of assets (favoring technological over non-technological assets such as marketing assets)²⁷. Asset accumulation related to 'marketing' goes beyond the usual 'understanding of needs/

²⁵We should distinguish this from Industry Consolidation, which may be a major factor spurring foreign acquisitions of small domestic companies.

²⁶Undertaking an IPO will accelerate this process of consolidation considerably so issues of 'IPO timing' are critical - too early will make it less successful and with weaker 'dynamic' effects on company consolidation; too late will miss an opportunity both for achieving high capital values and for accelerating consolidation (we will see that IPO frequently in very successful companies will be undertaken early during Phase 2 which is consistent with a trend leading to subsequent 'consolidation').

²⁷This seems to be stronger for Israeli Start Ups than what it is for its counterparts in the US(the latter are perceived as being much more demand oriented even at the beginning).

market' or 'marketing' as 'flow concepts'. It rather refers to market, marketing and client-related asset including 'reputation'. Moreover since the main Data Security market after diffusion of the Internet has and is the US (where most competitors are located) successful growth requires a significant accumulation of (or access to) marketing and client related assets which are specific to that market. A company which is acquired by a foreign company may enhance its *access* to such assets but the effect on accumulation of such assets may be negative²⁸; On the other hand a company which follows an indigenous path generally will be involved in a strong process of accumulation of such assets throughout (or in the pursuit of contractual arrangements to access them). Normally in the short run it will have to find a way to access such assets (externally). Marketing agreements here would play a very important role.

3.2 Types of SS Company Growth Profiles

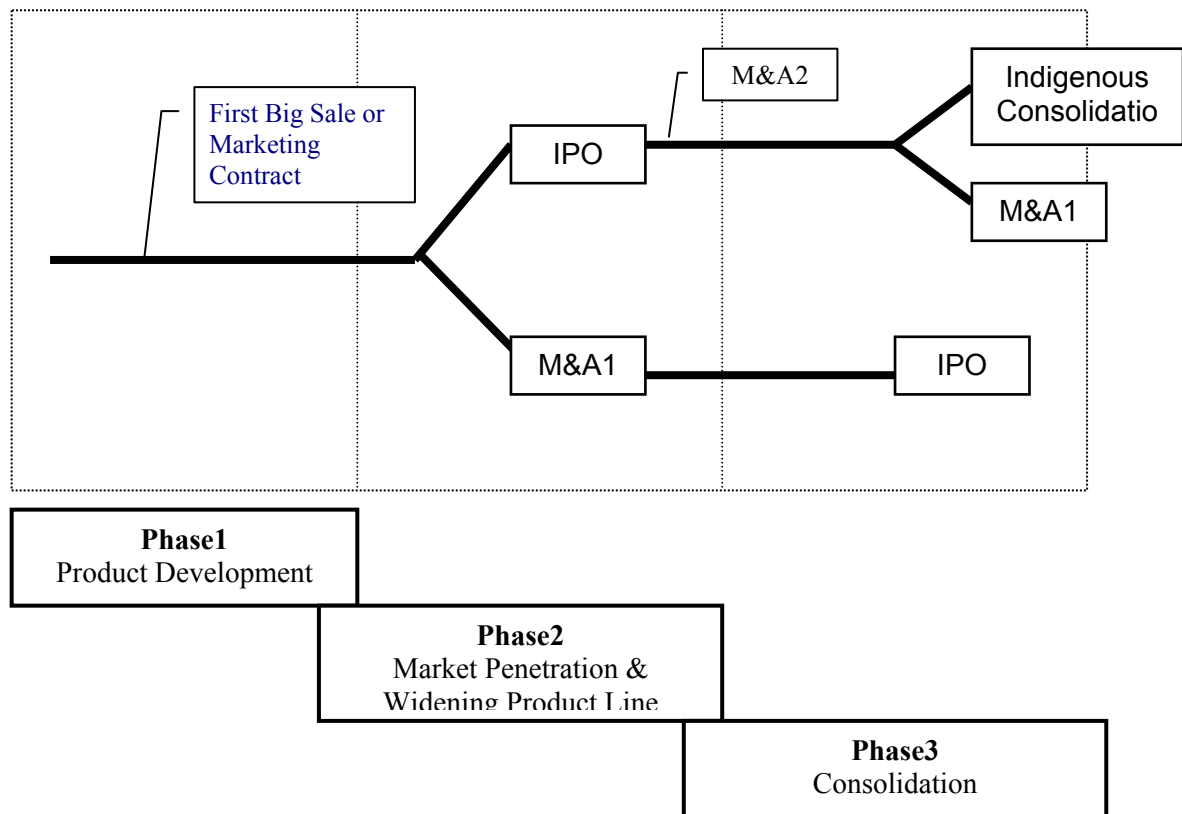
Figure 1 presents a stylized Phase Sequences for the four SS companies which reflects, *grosso modo*, their history. They are obtained by superimposing a *small number of events, particularly internationalization events*, on the sequence. Central among these are the IPO (followed by Memco, Aladdin and Check Point) versus the M&A1 alternative (followed by NDS) at the Market Penetration\Widening of Product Line Phase (Phase 2); and the two broad alternatives during the Consolidation Phase: Indigenous Consolidation (followed by Check Point); and Acquisition by a Foreign Company (Memco)²⁹. We have also included two additional "events" also reflecting strategic considerations: the "first big sale\marketing agreement" of the company (always occurring during Phase 1); and acquisitions by the Israeli company M&A2 (Phase 2 or 3). Needless to say. The profiles shown in the Figure do not include all of the information that could be included, but only that which seems to be critical for characterizing them in the context of Data Security³⁰. We see however that there is a *main phase sequence*, or *Main Growth Profile* which covers three companies: Check Point, Memco and Aladding; and *Special Growth Profile* -followed by NDS. Let us describe these.

²⁸This might have happened, at least initially, with the acquisition of Memco by Computer Associates in 1999.

²⁹See Figure 1. The essentials of the IPO -Indigenous Consolidation profile also holds for Aladdin once it began focusing in the US market (initially, before the Internet, it focused on Europe).

³⁰Additional research on a larger universe of very successful IT (rather than specifically Data Security) companies would lead us to finer distinctions among profiles. These would be based on the superimposition of additional information on the phase sequence e.g. Strategic Partnerships, etc.

Figure 1: Growth Profiles of Very Successful Enterprises



Explanation

The upper Main Sequence leads to Indigenous Consolidation (CheckPoint, Aladdin) or to Foreign Acquisition of the Israeli Company --M&A1 (Memco). The lower Special Case involves M&A1 early in Phase2 (NDS).

Notation

M&A2 represents acquisition of other companies (domestic or Foreign) by the Israeli company.

M&A1 is acquisition of the domestic company by a foreign one.

Characteristics of the Main Growth Profile("early IPO track")

- Successful Development and Initial Marketing in Phase 1 opens up the possibility of undertaking an IPO early in Phase 2. The IPO becomes an important component of the Market Penetration Strategy of that phase

- An early IPO opens up a number of possibilities for Phases 2 and 3. Thus all three companies following this course have undertaken acquisitions of both local and foreign companies subsequent to this event(M&A2);
- There are two main configurations of Consolidation--Indigenous and becoming part of a foreign company (M&A1).

Our casework shows that a minimum level of "achievement" is required for an IPO³¹ and that this IPO takes place in Phase 2 rather than as part of company "consolidation". We should again emphasize that the "early IPO track" of SS companies is a critical factor in those company's subsequent growth. This because success in the US 'capital market' (Nasdaq) by raising reputation, credibility and trustworthiness, is almost a *sine-qua-non condition* for generating links with important customers (a critical step in US market penetration of SS companies). IPO is an element of firm strategy rather than a simply a method of 'exiting' for VC and other investors³².

Special Case (the "early M&A1 track")

The main feature here is foreign acquisition of the local company--M&A1-- already at Phase 1 (end, or beginning of Phase 2). A major function to be served is Market Penetration and therefore this action is in effect a substitute for IPO.³³

General Remarks (both profil)

- IPO and M&A1 are *substitutes* in the early Market Penetration Phase of Very Successful Companies. Both are capital market transactions which enhance access to Complementary Assets (Teece 1986, op cit). They differ in that the IPO both directly and indirectly enables the company to accumulated or transact for the acquisition of such assets (or services from such assets) while M&A generally enables the acquired company to make *in house* use of the parent's Complementary Assets;
- IPO in NASDAQ seems to be a *necessary condition* for a company's products to succeed in the US market without losing company identify i.e. while remaining *indigenous*
- There are two *patterns of foreign acquisition* of a very successful Israeli Information Security company(M&A1):during market penetration (Phase1-2 of the *Special Profile*) as part of the process of gaining access to Complementary Assets; or during the (and as part of) the consolidation process of the company(Phase 3, part of the *Main Growth Profile*).
- IPO and M&A1 could be *complementary*. In the *Main Sequence* the IPO precedes the A&M1 without foreclosing a future Acquisition (case of Memco). In the *Special Case* either there is no IPO at all or the IPO comes after M&A1 (NDS was acquired in the early 90s and underwent an IPO in late 1999).

3.3 Explaining Company Growth Profiles FACTORS EXPLAINING A 'FAST IPO TRACK'³⁴

³¹ It seems that some sales are inescapable as proof that there exist customers who see the product as satisfying their needs (things might differ as regards to this point with respect to Internet Companies and during 'bubbles'). The minimum level also includes some consensus about the 'quality/potential' of the innovation and of the team conducting the firm.

³²This has been analyzed in Teubal et al 2000 op. Cit but is not reported here due to lack of space.

³³The acquiring company could be an important client with important marketing capabilities.

	Firm Strategy and Founders' Preferences	Existence of Experienced VCs	Country Hi Tech Reputation	Level of Nasdaq Index
NDS(acquired In 1991)	<i>NA (or neutral)</i>	<i>No</i>	<i>No</i>	<i>Low</i>
Aladdin (1993)	<i>Strongly Positive</i>	<i>Few</i>	<i>Fair</i>	<i>Fair/Good</i>
Memco (1996)	<i>NA or neutral</i>	<i>Yes</i>	<i>Strong</i>	<i>Very Good</i>
CheckPoint (1996)	<i>Strongly Positive</i>	<i>Yes</i>	<i>Strong</i>	<i>Very Good</i>

The box summarizes some of the factors explaining choice of a 'Fast IPO Track' company growth profile (Aladdin, Memco and CheckPoint) or alternatively, choice of a 'Fast M&A Track' profile by NDS. The factors include factors internal to the firm -- Preference of Founders; Company Strategy- and factors external to the firm. The latter include the External Environment of the country e.g. the Nasdaq index; and Characteristics of the wider High Tech Cluster e.g. the Reputation of Israel's high tech industries; and existence or no of an experienced VC industry (an experienced industry is considered to be essential for undertaking the more difficult IPO process relative to the 'easier' M&A' process). There are also other factors e.g. Area characteristics such as whether or not Data Security companies had to consolidate with Network Equipment and Software companies. The entries are self-explanatory, the conditions determining the *main* growth profile continuously improved during the 90s, so that with time, *grosso modo*, very good SU companies had better and better opportunities to undergo a 'Fast IPO track'. As mentioned, this reflects both the external environment (Nasdaq Index) and the 'maturity' of the high tech cluster (quality of VCs and country high tech reputation).

An important point is the role of Company Strategy including the preferences of founders/inventors and early investors. Our interviews show that some entrepreneurs had a strong preference for creating large (will ambitions of becoming global) indigenous companies, and this undoubtedly was a factor (or a factor reinforcing the other factors) in the decision to follow that 'Main' growth profile. Note that such preferences also affect which Consolidation Variant will be chosen--either indigenous consolidation or 'late' acquisition by a foreign multinational. It is our opinion that the decision of Memco to sell to Platinum was significantly influenced by Strategy and founder preferences, although other factors were also important.³⁵

4. BRIEF COMMENTARY ON GLOBALIZATION

³⁴Yes, Strong, Good indicate a favorable effect of the variable on a 'Fast IPO Track'; No, Weak, Low imply a favorable effect of the variable on the alternative 'Fast M&A Track'. The 'Fast IPO Track' of Aladdin should be reinterpreted to mean 'after its re-orientation towards the US Market in the first half of the 90s'.

³⁵One of the founders argued the inevitability of the late Acquisition on the basis of a process of Industry Consolidation(to his mind , one taking place in the Software Industry as a whole, not only in Data Security)

The process of “Globalization of Asset and Capital Markets” has proceeded one step further during the 1990s—it is involved not only in “Global Production Networks” but also in the upstream and extremely uncertain activity of New Product Invention and R&D. In North America for some time already, and for the first time in history in selected geographical areas beyond-- creative inventors and entrepreneurs have an opportunity to sell part or all of their young SU companies in world public (stock markets) or private (M&A; VC investments, angels, individuals) capital markets. Two important implications follow: *first*, the returns to inventors and investors/entrepreneurs in SU companies will be higher than what they would have been prior to the onset of the current Globalization wave; *second*, the resources raised (and other factors linked to participation in such markets) create new opportunities for accessing Complementary Assets. We will refer to each one of these effects separately.

Higher Rate of Return to Inventors/SU:

Whereas in the past materializing the returns to inventors/entrepreneurs/early investors associated with new high tech products required significant production and sales, and correspondingly significant investments in complementary assets (Teece, 1986)- today under the new conditions they may obtain an anticipated or relatively ‘early’ return on their investments by “exiting” in asset/ capital markets. It is worth mentioning that there are exiting options beyond being acquired by a foreign company (M&A) like selling a share of ownership (rather than full ownership) so the company can remain indigenous and eventually proceed along a full-fledged post SU trajectory. The options are VC and Angel investments; and IPOs. Another important point is that exiting in general may take place with few prior investments in complementary assets (relative to the level of investments required for successful marketing, sales and positive profitability).

More Resources for Accessing Complementary Assets:

The same exiting operation generates resources for purchasing or accessing complementary assets or alternatively, for materializing ‘R&D Leverage’ potential. Moreover, beyond the cash and shares raised, the process of VC investment or the IPO process directly generates new complementary assets such as Reputation, Visibility/ Exposure, new & reinforced Links & Networks; and new Management Skills

The direct and indirect role of IPO s in accessing Complementary Assets is the basis of our view that such an event is part of a wider process of Market Penetration by good companies rather than simply an exit mechanism for investor. There is a link here with Teece’s recent analysis (see Teece 2000, Chapter 1), for while we have mentioned the enhanced ease of accessing Complementary Assets in the current era, Teece points to a number of explanatory factors e.g. decreased cost of information flows, expansion of intermediate product markets, etc. He also sees this as part and parcel of the transformation of the sources of Competitive Advantage in the direction of a new logic where ‘developing, owning and deploying or orchestrating intangible assets which are not easily replicable’ is critical for competitiveness.

Our conclusions, originally appearing in Teubal et al (2000), are consistent with the conclusions of Teece. Both analyses emphasize that in the new environment accessing Complementary Assets seems to be ‘easier’ than what it was traditionally. However neither analysis, by virtue of their emphasis on the role that Management

plays either in Dynamic Capabilities (Teece) or in 'R&D Leverage' (this paper)-totally wipes out the role that Accessing Complementary Assets still plays in generating Competitive Advantage at the company level.

Moreover, there are also differences in emphasis. This paper has focused on the problem of developing High Tech Industries in Peripheral Countries or Regions, particularly those like Israel, which are small and relatively sophisticated technologically speaking. In those countries/regions, accessing assets (and technologies) complementary to those developed in domestic SU is a major issue for the competitive advantage & growth of such companies. Moreover, the conditions under which such assets are accessed will determine the nature and scope of the country's Comparative Advantage in High Tech e.g. how much high tech, and what share of SU is justified. In this context, the globalization of Capital/Asset markets - in the sense that there exists a social institution where 'good' inventors and SU may systematically both obtain a return to their investments and get access to resources for further expansion - is certainly one of the determining conditions.

The above is also, in our opinion, a factor to take into account in the analysis of high tech in Advanced Countries (particularly in Regional Analysis, and in the spread of the Silicon Valley 'model'). Under the new conditions, Peripheral Regions in these countries, with a greater likelihood than before, will also join the high tech bandwagon.

There are strong indications that Israel is one of the few non-North American areas where such 'participation' in world capital and asset markets has taken place. The best indicators are numbers of IPOs compared to other countries and normalized by GNP, population or other parameters; and Capital Raised and Invested by VC companies, also compared to other countries and normalized. Suffice for our purposes here to describe the general situation rather than to present a complete set of data on these matters. Concerning IPOs -many observers have indicated the large numbers of Israeli IPOs on Wall Street and the high share of technological stocks in accumulated IPOs. Until at least 1997/8 the Israeli total exceeded the cumulated total of all other countries except the US & Canada (Blass & Yaffe 2000). According to one estimate the accumulated number of high tech IPOs (overwhelmingly in Nasdaq) to 1999 was 83 where 46 were non VC-backed companies, and 37 were VC-backed (Lukomet 2000). There is some increase in yearly numbers of IPOs throughout the 1990s (until the recent crisis in NASDAQ) and in the share of VC-backed IPOs; and a reduction in size and age of companies undertaking IPOs during the second half of the 1990s compared to the first half. Thus hopefully the global capital market in conjunction with the local high tech cluster, are increasingly working in the direction mentioned in this paper, namely in supporting the effort of 'good' SU to enter the post SU phase.

SUMMARY AND IMPLICATIONS FOR OTHER PERIPHERAL ECONOMIES

Continued Globalization of Asset/Capital Markets(with respect to Invention/SU companies) together with the diffusion of the Silicon Valley Model of high tech to other areas will enhance the possibilities of creating high tech industries beyond North America. A subset of small and large Peripheral Countries--Israel, Ireland, China, India, South Korea--has or will benefit. They have or must acquire the requisite infrastructure, ample and high quality human resources and a favourable cost situation(e.g. 'low' salaries of engineers, low taxation, etc) especially in the early phases of high tech development.

The stimulus to high tech operates both at the SU phase of companies (by assuring returns to inventors prior to achieving significant sales and profits) and at the post SU phase (through new possibilities for accessing/acquiring Complementary Assets). For technology & skill intensive peripheral countries access to Complementary Assets for penetrating main overseas markets (e.g. the US as in the Data Security sector focused in this paper) is crucial. Firms in these countries have a distinct *dis*-advantage in this respect compared to their competitors in Advanced Countries. The ‘appropriability constraint’ to inventors & first innovators of a new product class (as analyzed by Teece 15 years ago in the context of Advanced Economies) re-appears today in a different form in Peripheral Economies. On the one hand, the problem is more acute in Peripheral Economies than what it is in Advanced Economies; on the other hand, the process of globalization of Asset & Capital Markets presents new opportunities for accumulating or accessing such Complementary Assets, directly or indirectly (e.g. through an “Early IPO” strategy for very good SU companies).

The new Globalization context, however, creates new problems and challenges as well. A major one for technology & skill intensive economies of the Periphery is related to the widespread process of Acquisition of very good SU companies(which is part and parcel of the same process of globalization). The massive dimensions of this process in the last years prior to the fall of Nasdaq in 2000, raises the issue of the distribution of gains between the country generating the SU companies (the equivalent to Teece’s ‘inventor or first innovator’ in his 1986 article) and the large IT high tech multinationals which acquired them. Is it desirable to develop a High Tech sector with a lion’s share of activity devoted to the generation & sale of SU companies? Or is it important that a non-insignificant share of IT high tech activity be devoted to Downstream Production and Marketing activities, processes undertaken in post SU companies? In other words is it true that the successful adaptation of at least some small, technology & skill intensive Peripheral Economies to the requirements imposed or the opportunities opened up by Globalization and the ongoing Technology Revolution requires not only a dynamic process of SU creation but the generation of large numbers of post SU companies including indigenous ones, some of which will become global leaders in their markets?

Some of these issues are explored both theoretically and empirically taking Israel’s IT high tech cluster and its Data Security Sector (and important Software sector) as an illustration. The paper stresses a micro-economic, firm level analysis of Israel’s Data Security sector; and only very briefly considers “macro” IT high tech issues. Company interviews, a survey of firms and additional information helped us map the whole (or almost the whole) Universe of Data Security Firms till mid 1998(19 firms). We identified the four (4) very successful (“SS”) companies, which comprise the core of our micro, firm-level analysis, and which represent 80-90% of Data Security Sector activity in 1999. In this phase of the research we also detected the importance of Foreign Acquisitions of promising Israeli companies (two out of the four very successful companies; and four out of six ‘moderately successful’ ones). Our research also revealed important information about the nature, timing and role of internationalization events such as Initial Public

Offerings (IPOs), OEM agreements, and Acquisitions by Israeli companies(both within Israel and in the US).

A major macro issue emerging from the analysis is the actual and the 'desirable' share of SU output over total IT high tech output (or exports); and corresponding to this how much effort should be put on accessing complementary assets. Both issues are clearly linked to the extent of foreign acquisitions of Israeli (or peripheral economy) SU. We contend that despite Israel's Comparative Advantage in SU its specialization in this segment of IT activity should be Incomplete i.e. that side by side with the generation of SU who are later being acquired, a segment of growing indigenous companies with Downstream Production & Marketing activities should be developed. This for a number of reasons -employment, managerial inputs (and other spillovers) flowing from such companies to SU, etc Achieving this goal may require the streamlining of existing biases in Innovation & Technology Policy which focused (till the last couple of years) disproportionately on R&D & 'neoclassical market failure' rather than on strengthening both R&D & non-R&D factors. In Israel, policy should contribute to overcome *systemic, institutional & market failure associated with the generation of post SU companies*. This is a great challenge for the future. Fortunately the increasing maturity of Israel's high tech cluster (particularly of Venture Capital) may also contribute to this end.

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