

The Jerusalem Institute for Israel Studies

***THE ISRAELI SOFTWARE INDUSTRY:
ANALYSIS OF THE INFORMATION
SECURITY SECTOR***

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Objectives

There are two main objectives of the analysis: first, to study the *emergence and development of the Information Security Sector in Israel*; and to *derive policy implications* from the analysis. This document will focus on the first objective. Policy conclusions will be considered jointly for two segments of Israel's hi-tech industry and will appear in a separate document. The two segments are- Information or Data Security, a segment of the Software Industry (this report); and Communications Equipment(a segment of hi-tech 'hardware' industries) which is dealt with in another report.

Data Security started from scratch in the mid 80s and a total of 19 firms comprised the "Universe" till 1999, all of them having begun as hi-tech start up companies (SU). We will see that a central aspect of the evolution of Data Security is the emergence of a small group of *very successful companies* who not only dominate sales, profits and market capitalization in the industry but who also have significantly contributed to the consolidation of Israel's hi-tech cluster of the 90s(an aspect of the *social impact* of such companies). One of the central analytical objectives is to analyze the *profiles of growth* of such companies, two of which remain as *indigenous global* companies and two of whom have been acquired by large foreign multinationals. Our analysis will be conducted in terms of two main groups of variables--*phases of company growth* and *strategy*. We will see that there is a *main phase sequence* characterizing three very successful companies and a *special case* corresponding to the fourth. Clear profiles of growth emerge from the analysis. These are linked to a *small number of patterns of internationalization* as represented by Penetration of Foreign Markets, Initial Public Offerings(IPOs) in Nasdaq, Acquisition by a foreign multinational(M&A1), and other factors. In the main sequence of very successful companies for example, IPO is part and parcel of a broader strategy of (US)market penetration (company phase 2) and growth. It requires a measure of initial success and revelation of potential but it is itself a 'cause' of success in the subsequent, consolidation phase (phase3) in the evolution of companies.

Why Information Security? This because of a number of reasons. First, it is a relatively well defined segment of software with a lower degree of heterogeneity compared to other segments. Second, Israeli companies were world pioneers in the sector and the Israeli segment today is an important and well integrated part of the

"world" Information Security Industry. Thus, having had a comparative advantage in this sector the stages of development of the Israeli component of the world industry might quite well reflect similar stages in the development of the world industry. The third and no less important reason for having chosen (within Software) to focus on Information security is the possibility of covering the whole "universe" of firms, thus avoiding difficult and almost inevitable problems of sampling bias.¹

A no less important reason for having chosen Information Security is Methodological since this is another objective of our research. More concretely one of our objectives is to flesh out a methodology of *policy-relevant research* in areas of rapid change, involving sharp processes of globalization and with respect to which relatively little codified knowledge exists. These features characterize Israel's hi-tech industry particularly during the nineties due to the rapid growth of start-up (SU or NTBF) companies involving both Venture Capital and strong links with international (especially US) capital markets. The fact the Information Security is 'relatively compact' and relatively accessible to us is an opportunity not to be missed. We will show that a mix between microeconomic, firm-based analysis on the one hand, and cluster & policy analysis on the other is critical. Needless to say that the full significance and implications of this paper require additional empirical work and additional recourse to "theory" and "knowledge" in a variety of areas within Economics, Sociology, Business Administration and Policy Analysis. Our paper is only a first and limited step in this direction.

1. OVERVIEW OF DEVELOPMENTS IN THE DATA SECURITY AREA

The data security area emerged during the third (and present) phase in the development of the computer industry--the Networking Phase of the 1980s(Malerba, Nelson, Winter 1997). 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

¹ The problem is not wholly eliminated; it rather shifts to the issue of defining the "boundary" separating Information Security from other related segments.

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.

1.1 Stages in the Development of the Information Security Segment

Stage 1 (1980-1990)

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).

Antivirus

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 part 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 note worthy 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 significant increases in the subsidies extended to industrial R&D². These changes had an impact on all stages of the development of the Data Security Industry.

3

Stage 2 (1990-1996)

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 their 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

² The 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 e.g. to external investors or Venture Capitalists.

³ Despite 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).

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 open 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, Eagleeye, 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 “Yozma” a Government owned VC fund which is credited with triggering development of the VC industry in Israel during this decade. In less than a decade the number of VC funds in Israel rose from 1 to more than 70 funds. A billion dollar of funds was raised this year alone by Israeli VC firms. 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 (Venture Capital funds of various kinds, private and strategic investors, foreign companies and financial institutions, OCS grants, etc).

These changes in the support structure to the business sector had a strong effect on high tech industry in general and the information security sector in particular (particularly in stimulating ever increasing waves of start up companies). The effects were reinforced in information security by the fact that it 'sits' on an important crossroads between the Internet and E-commerce and by having a good track record.

1.2 Key Concepts and Main Product Classes

AntiVirus

This is software that gave specific solutions to known viruses. As the viruses advanced the firms started giving solution to whole categories of viruses so that an anti virus software could work on a virus that was developed later in time. At this point, standardization for evaluating anti virus software was 'the percentage of known viruses it would identify and remove and that of unknown viruses it could identify and remove'. From this point on the concept of anti virus software did not change dramatically.

Software Protection

Software based or Hardware based means created to prevent illegal use (Piracy) of software. All technologies are based on encryption scalabilities that use for encrypting initial parts of the software. As most of the software industry turn to ship software via the public network, Software Protection tend to be more sophisticated.

Encoding and Decoding(Encryption Methodologies)

We refer to encryption technology for messages that run over networks (local or public). The basis for this encryption came mainly from academics in the math and statistical field. The first generation of encryption was based on a symmetric key, in which the encryption key and deciphering key are identical. Anyone holding the key can both encrypt and decipher a message. The second generation of the encryption was based on the principle of the a-symmetric key, in which there is an encryption key and a deciphering key. Anyone holding an encryption key can only encrypt and anyone with a deciphering key can only decipher.

Firewalls

The next stage in the technology development of the information security sector was protection of data within an organization from an outside network. The solutions for this used firewall technology .The idea is to establish a gate keeper at the main entrance to the organizational server who lets only authorized users in.

Virtual Private Networks(VPNs)

Technology that gives security solutions for organizational data transferred over the public network. VPN solutions are based on data encryption methodologies specially designed for encrypting the TCP/IP protocol.

Server Protection

Products designed to protect weak points in the system such as databases, etc.

Managing and Auditing Products

Products designed for integrating other products' capabilities (within the security system and the network system). As most of the security breaches are revealed after being done, there is a need to record and analyze all events. This in turn led to another group of products for monitoring and logging of all events in the network.

Access Control

Means like smart cards, tokens, plug -ins designed for authorized access to individual PCs or to workstations linked to a network. It includes a recent trend of shifting to user (rather than computer) identification.

Mobile Code

Small programs based on Java or ActiveX, etc languages that enable applications to be transmitted, opened and executed without having to download the whole software. These applications are used by hackers to penetrate and spy or vandalize PCs, servers within organizations while pretending to be friendly(electronic Christmas cards, e-mail, video and audio files, etc).

The order of the above list to some extent reflects the chronological development of the technology\products in the industry.

2. THE UNIVERSE OF "DATA SECURITY" COMPANIES

2.1 The Sample and its Characteristics

Our sample includes 19 companies who were created in one of three possible stages: an *early* stage A(1980-1990)-- four(4) companies; a *middle* stage B(1990-1996)--seven (7) companies; a *mature* stage C (1996-1998)--eight (8) companies. Stage A include companies who were created in the pre-Internet phase, implementing encryption algorithms for software security and network communications; as well as software houses that developed anti virus software. During stage B the internet revolution took place with the effect that the companies being founded were devoted mostly to protecting the organization and its data bases from external and internal threats. The two main areas are internet security and internet-compatible network security. Stage C companies-- who appear when awareness to security problems already exists in the market-- attempt to link their activities to emerging trends such as mobile code(Java, ActiveX) hazards, or e-mail security, and they tend to specialize in very specific niches.

The sample pretty well covers the Data Security sector 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. At this point "security" for us includes 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.

The above means that we should not be surprised that there is no formal "roster" of "data security" companies which could serve as the universe from which we could have sampled our companies. The volume "The Israeli Hi Tech Guide for the Year 1999 " includes 16 companies under the category "Security" a number of which are advisory\consultants companies rather than hi-tech start up companies⁴. Moreover, some of the most important companies in the field were classified as

⁴ Dolev & Abramovitch, "The Isreal Hi Tech Guide for the Year 1999", Meida Technologi, Inc.

"Software Companies" rather than "Security" companies. When we identified the 19 companies in our sample we thought that they would comprise the whole universe. It turned out however, after six months of intensive interviewing, that another 10 companies approximately could also be included in the universe(in addition to a number of companies who closed). What we can be sure of is that we included the most important companies which are market leaders in their field (see successful companies in the next section).

Table 1 and 2 gives qualitative information on these 19 companies. In addition to foundation date and stage we have information on *-products and product families*; *source of initiative* (independent, backed by an existing company, or incubator); *status of the company today*(independent non-public company, public, subsidiary, incubator, acquired by a foreign company, acquired by an Israeli company, closed); *Initial Public Offering* (yes, no); *Initial financing*(first year- Venture Capital, Strategic Partner, Backed by an Existing Company, Bootstrapping, Office of the Chief Scientist); and *Location*(city, area). In addition we have quantitative information on individual companies (Sales & Sales growth, Employment & Employment growth; and Market Capitalization): we do not have complete information on these for all companies(especially on sales) and even for those we have, we abstain from presenting the absolute values for individual companies(except on Market Capitalization).

TABLE 1: CHARACTERISTICS OF FIRMS IN THE ISRAELI DATA SECURITY SECTOR, PART-1

no.	Name	Year of establis-hment	phase at establis-hment	Products		Geographical Area
				number of products/ product families	Names & Technology	
1	<i>Abirnet</i>	1996	C	1	<i>SessionWall-3</i> -network monitoring and blocking	Haifa
2	<i>Aladdin</i>	1985	A	4	<i>HASP and Hardlock</i> - software security - hardware solution <i>Privilege</i> - Secured Enviroment <i>eSafe</i> - Content Security <i>eToken</i> - Access Control	Tel-Aviv
3	<i>Algorithmic Research</i>	1985	A	3	<i>PrivateWire</i> - communications Security <i>Crypto+family</i> - Cryptographic Components <i>Private+family</i> - Cryptographic Solutions including SmartCards	Tel-Aviv
4	<i>Aliroo</i>	1994	B	4	<i>PrivaWall</i> - E-Mail Security <i>PrivaSuite</i> - Windows Based, files encryption <i>PrivaSeal</i> - Digital Signature <i>SecureSentry</i> - Smart Card	Hasharon
5	<i>Check Point</i>	1993	B	7	<i>FireWall-1</i> - Network Security <i>VPN-1+family</i> - Network Security <i>Provider-1 FloodGate-1</i> - Bandwidth Managment - <i>Check Point RealSecure</i> - <i>ConnectControl</i> - <i>Meta IP</i> -	Tel-Aviv
6	<i>Cipher Active</i>	1995	B	1	<i>CipherActive</i> – Network Connection Security	Haifa
7	<i>Eagle eye</i>	1993	B	1	<i>Control-SA/Workflow</i> - Security System Managment	Tel-Aviv
8	<i>Eliashim</i>	1983	A	3	<i>Anti-Virus - Softwre Security</i> - <i>eSafe</i> – Content Security	Haifa
9	<i>finjan</i>	1996	C	1	<i>SurfinGate</i> - Content Security	Hasharon
10	<i>First Access</i>	1998	C	1	<i>VicinID+family</i> - Access Control	Haifa
11	<i>Memco</i>	1990	B	3	<i>SeOS</i> – Client/Server Protection <i>SessionWall-3</i> -network monitoring and blocking <i>Proxima SSO</i> - Single Sign On	Tel-Aviv
12	<i>NDS</i>	1988	A	2	<i>Data Broadcasting Satellite (DBS)</i> - line of products <i>Data Broadcasting Networking (DBN)</i> - line of products	Jerusalem
13	<i>NetGuard</i>	1995	B	2	<i>NetGuard Guardian 2.1</i> – Network Security <i>NetGuard Guidepost</i> - Bandwith Control	Haifa
14	<i>Pelican</i>	1997	C	1	<i>PelicanX</i> - Content Security	Tel-Aviv
15	<i>Rad Guard</i>	1994	B	1	<i>clPro+family</i> - Network Security	Tel-Aviv
16	<i>Seal System</i>	1997	C	1	<i>Authorizer</i> – DigitalSignature	Jerusalem
17	<i>Security7</i>	1996	C	1	<i>SafeGate</i> - Content Security	Haifa
18	<i>Vanguard</i>	1997	C	1	<i>MailGuardian</i> - E-Mail Security	Haifa
19	<i>Voltaire</i>	1996	C	1	<i>2in1</i>	Tel-Aviv

TABLE 2: CHARACTERISTICS OF FIRMS IN THE ISRAELI DATA SECURITY SECTOR, PART-2

No.	name	Initial Status			Status Today							IPO: Yes/No	sales growth % 97-98 ⁸	Employment growth % 97-98
		Independent	Backed by an Existing Company ⁵	Incubator	Independent non-public	Public ⁶	Subsidiary	Incubator	acquired by a foreign company ⁷	acquired by an Israeli company	closed			
1	<i>Abirnet</i>	*					Memco		CA (indirectly)	Memco		N		100
2	<i>Aladdin</i>	*				*						Y	6	36
3	<i>Algorithmic Research</i>	*					Cylink		Cylink			N	50	
4	<i>Aliroo</i>	*			*							N		
5	<i>Check Point</i>	*				*						Y	69	67
6	<i>Cipher Active</i>			*	*							N		33
7	<i>Eagle eye</i>		New Dimension				New Dimension		BMC (indirectly)			N	100	
8	<i>Eliashim</i>	*								Aladdin		N	32	21
9	<i>finjan</i>	*			*							N		67
10	<i>First Access</i>	*			*							N		350
11	<i>Memco</i>	*							Platinum → CA			Y	100*	116
12	<i>NDS</i>	*							News			N	33	19
13	<i>NetGuard</i>		Lanoptics				Lanoptics					N		
14	<i>Pelican</i>	*			*							N		133
15	<i>RadGuard</i>		Rad Group		*							N		79
16	<i>Seal System</i>			*							*	N		25
17	<i>Security7</i>	*							CA			N		75
18	<i>Vanguard</i>	*			*							N		
19	<i>Voltaire</i>	*			*							N		115
	TOTAL	14	3	2	8	2	4	0	5	2	1	3		

⁵ Full or Dominant Ownership and Strong Links\Support at Initial Phase

⁶ Excluding Public Companies which were acquired by another company

⁷ Indirect acquisition means acquisition of Parent Company

⁸ "**", 1996-1997

Highlights

1. The dominant share of companies (14 out of the 19) were created as independent companies. The remaining were created in Incubators (who are also partners to the project) or are subsidiaries of larger companies.
2. Independent companies are a much smaller share today--eight (8) companies out of the 18 companies that remain (one of the 19 companies closed). Six (6) out of the fourteen (14) were acquired by (or merged with) another company--in four (4) cases a foreign company, in two (2) cases a local company. Another two (2) underwent an IPO thereby becoming public companies under Israeli Management (CheckPoint, Aladdin). On the other hand two companies who were not independent initially (RadGuard who was part of the RAD group; and CipherActive who was at the Incubator) became independent companies.
3. *M&A*: Four (4) companies (Memco, Algorithmic Research, NDS and Security-7) were directly purchased by foreign companies and we have two additional cases involving such purchases but having a slightly different character. One involves Abirnet who, having been acquired by Memco, was "indirectly" acquired by Platinum (and eventually by Computer Associates) who acquired Memco. The other case is Eagle Eye, who as a subsidiary of a larger Israeli software company (The New Dimension) was 'indirectly' purchased by BMC, a large US software company. The four companies directly acquired by foreign companies belong to the category of "successful" (see next section). Thus six (6) of the ten (10) firms in the "successful" category were directly or indirectly purchased by a foreign company. This *does not* include CheckPoint, the most important of all.

4. *Employment, Sales and Market Capitalization*⁹

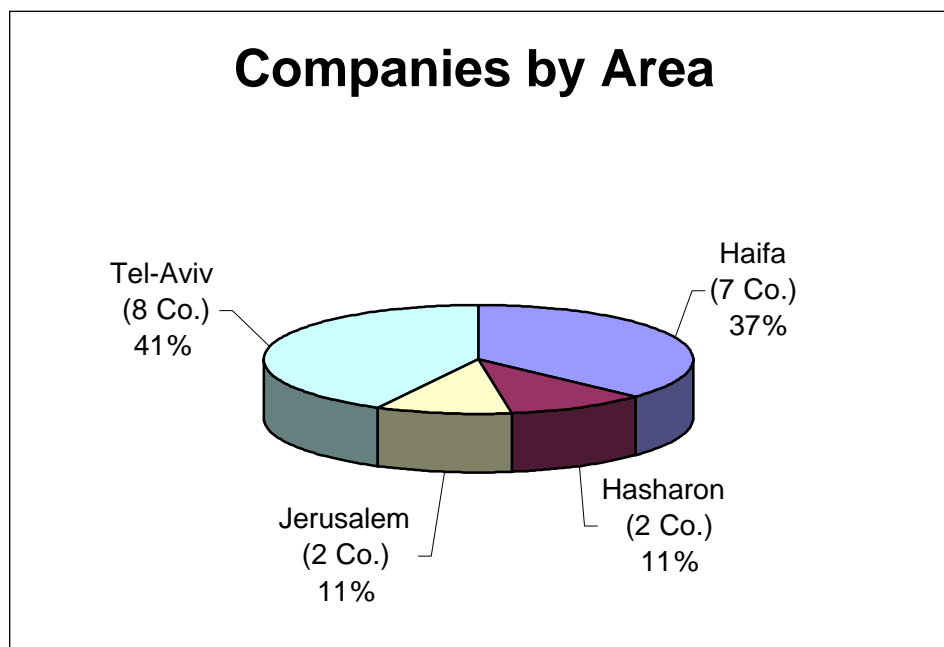
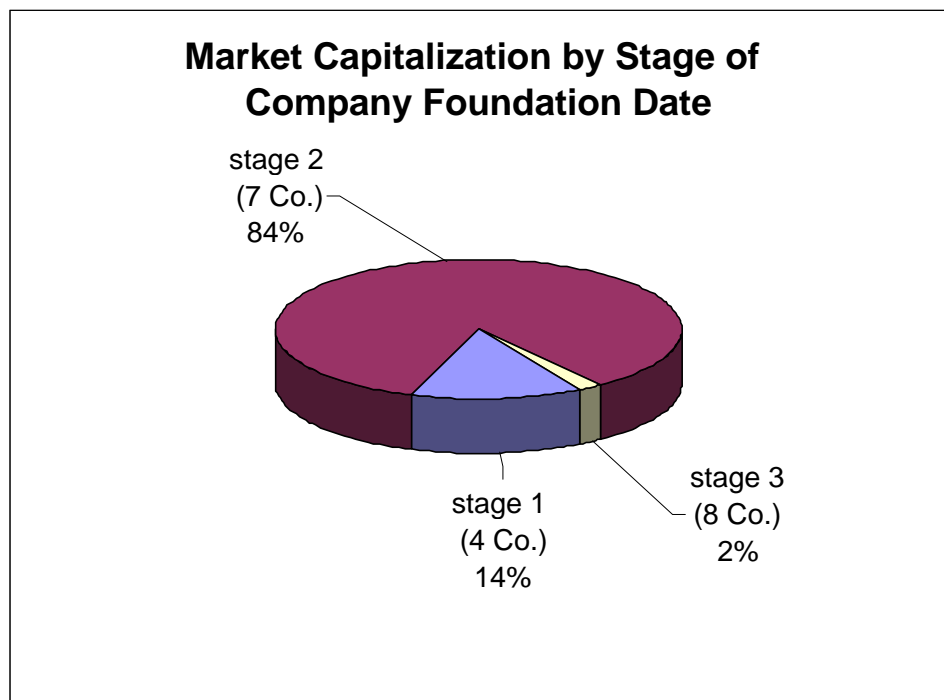
Aggregate employment of 14 (out of the 19) companies was 1816 employees in 1998; aggregate sales for 14 companies during 1998 amounted to 406M\$ (sales data of two companies are 1997 figures); and estimated market capitalization of the group for October 1999 surpassed 6500 M\$¹⁰. There are problems with the

⁹ Table shows *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 where we have it).

¹⁰ The CapMark value is much higher in November/December 1999 due to the continued growth of value of shares of existing companies and due to the public offering of 10% of NDS's shares.

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 sources (since only three companies are publicly traded companies) and refer to different periods, depending on the date of an M&A operation or the date of a Venture Capital

Figure of the M&A process



investment in the company. The overwhelming share of market capitalization corresponds to companies who were founded during stage 2 (1990-1996) of the data security industry of this country (maybe 80% of this value corresponds to one company-CheckPoint).

2.2 Summaries of Major Companies

Summaries of the four companies with larger market capitalization, employees, sales are shown below.

Checkpoint summary

Gil Shwed, Shlomo Kramer and Marius Necht founded Checkpoint in 1993. In the seed stage BRM 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 company, 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 security but not to move into other fields. In order to implement this strategy Checkpoint established OPSEC – a 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). 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 compan.

Chehas had a decisive influence on the information security sector in general and on Israeli companies in this area. The influence Checkpoint had 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. Checkpoint has gone public in 96 with a market value of 500 million and has reached today (10/99) a market value of 4.8 billion dollars. It currently employs over 560 employees.

Memco summary

Memco was founded in 1990 by Israel Mezin and Eli Mashiach -- one of the first companies in information security in the world. 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 Plantium who in turn was acquired by Computer Associates (company evaluation- 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 coordinates 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 this year). The position of the former Memco in CA's organization is indicative of the important role played by that company in the worlds information security market (a role which could be strengthened after its sale to CA) as well as its capabilities today.

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 summary

Aladdin was founded in 1985 by Yanki Marglit with a 10,000 \$ investment. The firm provided a hardware solution to software security/protection. It gained a respectable 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)¹¹. 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 its 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 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 are broader today: "to provide the leading systems of the management control and broadcast distribution of entertainment and information to TVs and PCs"¹². 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

¹¹ This very successful merger was documented in a case study of the Harvard Business School.

¹² **Israel's Electronics Industry Profile**, May 1988, p.57(a publication of the Association of Electronic Industries).

the largest firms in the data security field in Israel and one of the main in its field worldwide.

2.3 Performance: Categories and Distribution of Firms

Throughout we will be considering three groups of companies--Very Successful(SS--4 com); Moderately Successful(S-6 companies); and Other (O-9 companies)¹³. The O-category includes Failures (2 companies); Struggling (3 companies)); and young companies with potential-"Emerging" (4 companies--*Com9*, *Com4*, *Com11* and *Com5*). In Sections 4 & 5 we analyze similarities and differences among groups with respect to a number of features covered in the interviews.

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. 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 terms of the value of shares in the stock market --the first three had IPOs in Nasdaq(in the case of NDS the expected value of shares from a public offering that may take place shortly) or the value of the company during acquisition (the case of Memco or NDS).¹⁵

¹³ See Table 3. Due to sensitivity of the material the names of each one of the companies (excepting those of the SS group which are public companies) have been "coded" as *Com x* where x runs from 1 to 15.

¹⁴ Despite 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.

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

Table 3a: FIRM PERFORMANCE CATEGORIES				
VERY SUCCESSFUL(SS)	MODERATELY SUCCESSFUL(S)	OTHER(O)		
CheckPoint	Com2	Emerging	Failure	Struggling
Memco	Com10	Com11	Com12	Com7
Aladdin	Com15	Com5	Com6	Com13
NDS	Com1	Com9		Com8
	Com14	Com4		
	Com3			

Table 3b: Companies by Performance Category and Foundation Date			
O	S	SS	Stage
	2	2	A: Early
3	2	2	B: Middle
6	2		C: Mature
9	6	4	Total

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 a M&A or the valuation incidental to a Venture Capital investment. In three cases (*Com10*, and *Com3*) both the sales and the valuation conditions were fulfilled; in two cases (*Com14* and *Com15*)- only the company valuation condition has been fulfilled; and in the remaining cases(*Com2* and *Com1*) only the sales conditions holds(a reasonable estimate would however give these companies also a condition- fulfilling company value). This group includes two relatively "older" companies (*Com3* and *Com10*, 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 the third, consolidation, phase of growth of the industry(the remaining three were founded during the middle, second, phase). Clear "failures" can be found in two cases-a company founded in 1997 who closed(*Com6*); 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(*Com5*). "Struggling" companies lie somewhat in the middle.

2.4 Information from Interviews

The interviews of the 19 companies listed in the previous section have generated ample information over and above the basic information of Figures 1 & 2 ; and over and above the information obtained from the Questionnaires. This information is relevant for understanding processes of growth and performance of individual companies, creation and operation of the 'data security cluster' in Israel and the potential impact of both on the national economy. It will also help to interpret the results of any Quantitative Analysis based on Questionnaire Data which may be undertaken; as well providing elements of the context under which the follow-up policy analysis should be conducted.

The main aspects of enterprises and enterprise growth covered during the interviews are presented below. They include--

- *CEO (or Entrepreneur) Background and Experience**
- *Pre-foundation and early(post-foundation) learning, search and other activities undertaken.^{16*}*
- *Phases in the growth of companies**
- *Strategy\Firm Profiles**
- *Mergers & Acquisitions 1(M&A1): Foreign purchase of (or merger with) the Israeli company*
- *What happens after acquisition by or merger with a foreign company?*
- *Mergers & Acquisitions 2(M&A2): Israeli company purchase of a local or a foreign company*
- *IPO*
- *Cooperation*
- *OEM Agreements*
- *Standardization: OPSEC and other institutions*
- *Use of Venture Capital(VC)*
- *Marketing*
- *Regulation: blocking or stimulating change?*
- *Support by the Office of the Chief Scientist(OCS)*
- *Incubators-Impact and Effectiveness*

¹⁶ In a few cases this also includes "the product idea" and "bootstrapping" of the company.

- *Other Government Support; National Strategy, Strengths and Weaknesses of Israel*

Only a subset of the above features or characteristics will be considered (those with *) in the next four sections- and in most cases covering a subset of companies only(between four and fourteen). Interview time constraints limited the number of variables that can be considered for each company. Our approach was to let the entrepreneur\CEO 'tell his story in this own terms' with us intervening whenever we had relevant a priori knowledge to ask him to emphasize those aspects which seemed of great relevance for understanding other security companies(e.g.asking him to tell about the acquisition of his company by a foreign company with the intention of trying to uncover a possible 'model' about links between a local subsidiary and its foreign parent),

3. DYNAMICS OF COMPANY GROWTH AND POTENTIAL IMPACTS

3.1 Approach and Main Variables

The objective of our analysis is both descriptive and analytical. We want to identify "profiles" of company growth with high potential impact to the national economy(this includes private "success" *and* other factors). We also want to set the stage for integrating an analysis of company profiles into a wider cluster analysis and , on the basis of both, generate new policy insights. Note that the four very successful companies comprise a very high share of employment, market capitalization etc of the Information Security Sector. This amply justifies our attempt at identifying possible 'causes' of growth for these companies, an attempt leading to *profiles* associated with high (private) performance and high potential social (economy-wide) impact(this and next section) and the beginnings of an analysis of "causes". It also justifies conducting a firm-level analysis prior to or parallel to an analysis of clusters effects.¹⁷

The two central groupings of "independent" variables are *Phases of Company Growth*; and *Strategy*. These will be the central determinants of the following

¹⁷ The share of these companies in the overall information security sub-cluster is enormous and so is their impact on this sub-cluster(they are leading firms and even "key agents" in the sub-cluster creation process). Another reason for focusing on successful firm profiles is the "strategic" importance of large companies in the Israeli hi-tech cluster(see later on)

outcomes: *Profiles of Company Growth*; *(Private) Performance*; and *Social Impacts*. The sets of variables and outcomes are shown in Figure 4. Since we have already assigned (private) performance measures to the various companies and since a full analysis of "social impacts" requires a much broader perspective than what is possible in this paper as well as much more information--our focus as far as outcomes is concerned will be on *Profiles of Company Growth* as well as on some links between them and the other two outcomes(see Section 5). The third group of independent variables are *Initial Conditions*. Two should be mentioned here--the "quality\potential" of the invention\innovation embodied in the product focused by the company in its initial, "product development" phase; and the "Background\Experience of the Entrepreneur". Thus some very successful growth profiles depend on having a "high quality" invention\innovation which sets the company going; and an entrepreneur with very favourable characteristics(here represented by Background and Experience). But these are necessary but not sufficient conditions. On the other hand there is almost no chance that a successful profile of growth will characterize an Israeli company based on a 'low quality' invention\innovation.¹⁸

At this stage we make only very brief reference to variables pertaining to the overall context within which firms operate. Two groupings are important here: "cluster-related variables and effects" and "policy"¹⁹. It will be clear for example that the growth profile of Aladdin differs from that of other companies who appeared later (e.g. Check Point). One reason is the different "cluster effects" available at the Early Stage (A) of the industry when Aladdin was founded compared to those available during the Middle Stage(B).

Concerning the specific variables in each category especially concerning Phases and Strategies. More will be said later (especially in Section 4); here we will introduce the three 'basic' phases of company growth and name the various components of strategy with which we will be proceeding later on. There are three 'basic' Phases--Product Development(Phase 1), Market Penetration & Broadening of Product Line(Phase2) , and Consolidation(Phase 3). Every start up company starts with product development which comprises the bulk of the effort in its initial phase.

¹⁸ This paper will not define the quality\potential of innovations systematically, although it will be assuming (and there is some evidence to the effect) in the analysis of the four successful companies that their initial invention\innovation was of "high" quality\potential.

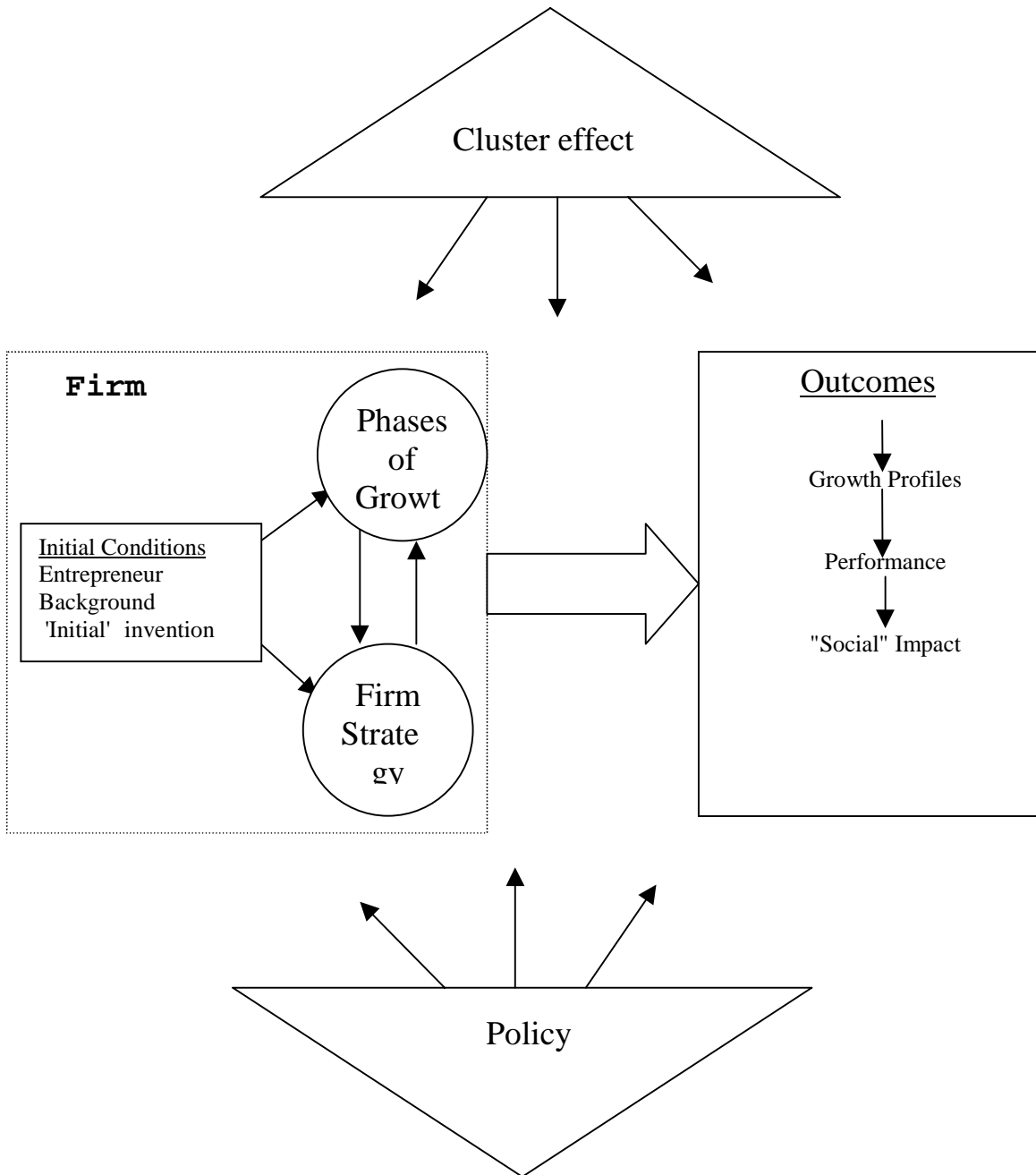
¹⁹ The stage of the security area is also a variable, it will be considered together with "cluster effects".

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 Market Penetration while, certainly in the case of very successful companies, initiating development of new products (advanced versions of existing products and other related products). This is Phase 2. The consolidation phase (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. Chief Financial Officer, 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).²⁰ Our intent here is to associate the above sequence with an "indigenous" growth profile of Israeli companies. Whenever an Israeli company is acquired by a foreign 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 economy 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, OEM agreements and even direct sales.

²⁰ Undertaking 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 during Phase 2 which is consistent with a trend leading to subsequent 'consolidation').

Figure 4: Company Growth and Potential Impacts



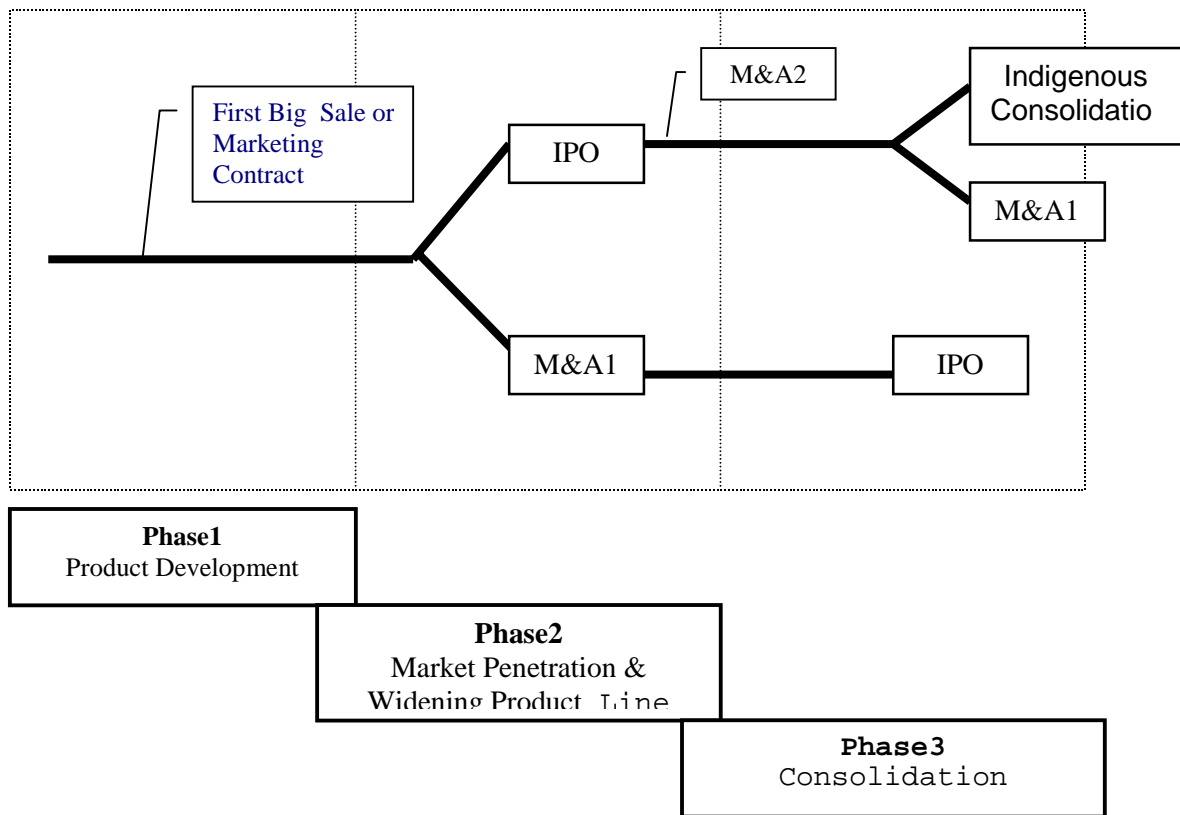
The variables included in "Strategy" or associated with Strategy-related events include -- *preferences of founders, first major marketing\sale agreement, IPO, acquisitions by a foreign company(M&A1), acquisitions of(or mergers with) other companies(M&A2); Marketing Strategy & Target Customers;* and the *Accumulation of Marketing\Market & Customer-related Assets*. The issue of asset accumulation seems to be critical since, Israeli companies start with a technological idea and frequently are characterized by a severe imbalance initially both in their outlook-- which is frequently 'technology push' rather than 'demand pull' (or a hybrid between the two)-- and also in the pattern of accumulation of assets--one favoring technological over non-technological assets²¹We refer here to the balance between technological and other assets; and concerning the latter it is important to mention that the perspective is not only to 'understand the market' or to 'do marketing' as 'flow concepts' but rather to accumulate assets related to the market, marketing and clients. Moreover since the main market of Security companies since the 90s 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 some of which are very specific to that market(the required 'bias' favoring these assets would seem to be higher for Israeli companies compared to that required for their US counterparts). 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 negative. On the other hand a company which follows an indigenous path may be involved in a strong process of accumulation of such assets throughout. It will however, have to find a way to access such assets(externally) in the short run. Marketing agreements here would play a very important role.

3 . 2 The Phase Sequence of Very Successful Enterprises

Most of the analysis will cover the four very successful cases: Aladdin, Check Point, Memco and NDS. Figure 5 presents a stylized Phase Sequence for these companies which reflects, *grosso modo*, their history. We superimpose only a *small number of elements of strategy* on the sequence:

²¹ This 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).

Figure 5: The Phase Sequence 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 **over** special Case involves M&A1 early in Phase2 (NDS).

basically IPO, acquisition of the Israeli company by a foreign company (M&A1); and the Indigenous Consolidation option. These generate two instances of branching-out: the IPO(followed by Memco, 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)²². We have also included two additional "events" also reflecting

²² HSee Figure 5. The essentials of the IPO --> Indigenous Consolidation pattern also pertains to Aladdin although there are some details which have to be sorted out first. This is the reason we have not included this company in the Figure

strategic considerations: the "first big sale\marketing agre" of the company (always occurring during Phase 1); and acquisitions by the Israeli company(Phase 2 or 3).

The Figure represents phase sequences for very successful companies which incorporate some elements of strategy or strategy related events. It does not, however, represent complete growth profiles of these companies since most of the information on strategy is still missing. We see however that there is *a main phase sequence* which covers three companies: Check Point, Memco and Aladding; and *special case (NDS)*. Let us describe these.

Characteristics of the Main Sequence

- Successful Development and Initial Marketing in Phase 1 opens up the possibility of undertaking IPO which becomes an important component of the Market Penetration Strategy of Phase 2
- The IPO opens up a number of possibilities for Phases 2 and 3. Three out of four very successful companies (all except NDS) 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 case work shows that a minimum level of "achievement" is required for an IPO²³ and that this takes place in Phase 2 rather than as part of company "consolidation".

Special Case

The main feature here is foreign acquisition of the local company--M&A1-- already at Phase 1 (end, or beginning of Phase 2). The major function to be served is Market Penetration and therefore this action is in effect a substitute for IPO.²⁴

General

- There are two patterns of foreign acquisition of a very successful Israeli Information Security company(M&A1): as part of the consolidation process of the

²³ 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). The minimum level also includes some consensus about the 'quality\potential' of the innovation and of the team conducting the firm.

company(Phase 3, part of the *Main Sequence*); or for market penetration (Phase 1-2 of the *Special Case*)

- IPO and M&A1 are substitute events in the Market Penetration Phase of Very Successful Companies; .
- Very successful companies who have been acquired by foreign companies(M&A1) have also undergone an IPO(the are "complementary") but there are differences among the two cases. When the foreign acquisition of the Israel company takes place during "consolidation" (Phase 3, *Main Sequence*), the IPO precedes the M&A1 and seems to be a major event on which the future of the company depends. When M&A1 takes place during market penetration (Phase 1, *Special Case*) the IPO takes place after the M&A1 , a long time may elapse, and its significance is altogether different and relatively minor.
- In most cases (all of the *Main Sequence*) IPO precedes A&M1. In the *special case* either there is no IPO or the IPO comes after A&M1.

3.3 More on Phases and Strategy

The VC-related typology of Phases

Our classification differs from the one in the literature dealing with Venture Capital²⁵. The phases of firm growth in that literature tend to focus on financial and administrative matters and decisions which a company should tackle\take since inception till exiting. In contrast our own way of defining and sequencing phases is based on the "functional" activities of the company, which--while having a financial\administrative aspect-- this is not the "thing" or function itself. Moreover we are interested in phases of growth even after "exiting" (either through IPO or M&A1) which VC classifications do not cover. Our classification will , however, bears a certain parallel to a VC-based classification. Thus our first "Product Development" Phase will correspond to the Seed & to the First Round phases of the VC-based typology; while our second "Market Penetration and Widening of Product Line" Phase will correspond somewhat to the Second and Third Round (which would

²⁴ The acquiring company could then be an important client or this together with important marketing capabilities.

involve activities such as International Expansion and Marketing Planning). On the other hand, our third "Consolidation" considers both "exiting" and "indigenous consolidation";²⁶ What VC's would term "exiting" will take place always in Phase 2 (NDS through sale to Sky; Memco and Check Point, through IPO); and frequently in Phase 3(M&A1 of Memco; IPO of NDS).

Sequential Causation

It goes without saying that the set of phases that a company undergoes depends also on its success in the marketplace (both product and capital marketplaces)and on the pattern of accumulation of assets more generally speaking. This would create a *pattern of sequential causation* where the experience, reputation, knowledge, links\networks, infrastructure and cash &other resources generated in early phases of a company growth are instrumental in propelling it towards subsequent, probably more complex and sophisticated phases²⁷. Thus a short lived company could adequately be characterized by one or two phases with very little intangibles and infrastructure carried over from the first to the second(a probable cause of firm disappearance after\during its second phase), whereas a successfully company by many more. Alternatively, success in a relatively early "simple" phase-- e.g. the phase that ends with prototype development of the company's first product-- may set the base for entering a more complex, and sophisticated subsequent phase where the company both attempts to penetrate the market for its first product while simultaneously broadens its product line (by initiating development of other products) and sets the stage for "penetrating" the capital market (through an IPO or through merger or acquisition with\by a foreign company).

The onset of a new phase may reflect not only the asset accumulation mentioned(which led to a pattern of sequential causation) above but also a change in the environment(new opportunities, new competition, etc). Frequently a change in strategy is involved, but there nothing automatic about this. Thus an unfavorable change will lead to a new phase whether there is or there is not a change in strategy.

²⁵ See for example "On the Right Track: An Entrepreneur's Guide to Success", published by Ernst & Young and BRM, Israel, 1998(especially between pp. 15-16);

²⁶ In our perspective a sharp distinction should be made between the two types of exiting--M&A and IPO; their sequencing; and considering both acquisition by a foreign company(M&A1) and acquisition by the local company(M&A2).

The new phase may be better adapted to the new environment if an explicit strategic reorientation of the company has taken place. But even without a change in strategy the company might very well enter into a new downspiralling phase.

Strategy

Phases of Company Growth involve the more descriptive part of the dynamic evolution of companies and they also could be *a reflection of Company Strategy*.²⁸ Company strategy is affected both by "preferences and disposition" of owners and by changes in the Environment facing the company. For example, if the strategy calls for selling the firm to a larger software company then indigenous growth will stop²⁹. Also "similarly" successful companies may have different profiles of growth (including different sets of phases) because of differences in strategy—compare the example mentioned above with a company which remains fully independent and, as part of its success, is continuously expanding its line of products, technologies and client base.

"Strategy" is the way the firm perceives it should proceed in order to achieve its aims (including the characterization of the aims themselves). It is a major factor in explaining what the firm does today in its current phase and whether or not it is time for a fundamental re-orientation and initiation of a new phase in its growth³⁰. On the other hand, what a firm actually does also depends on other factors ("environment"). Thus an unsatisfactory implementation of the strategy of T_0 may lead to a new strategy at time T_1 .

Another way of understanding strategy is to see it as a *set of principles or overarching aims and targets which can contribute to explain the links between the various phases of company growth*. Thus a gradual shift in marketing from dominant

²⁷ This has been the case of Elscint, a successful Israeli company in the nuclear medicine diagnostic area, during its first decade of existence (see Teubal, M. "The R&D Performance Through Time of Young, High-Technology Firms: Methodology and an Illustration", **Research Policy 11(1982)**).

²⁸ In a world with incomplete information, "strategy" will become part of the description of phases, not only a "cause" of a particular phase. Thus if a firm's strategy entails a diversification of its methods of marketing, this is also indirect, qualitative information about what it is currently doing.

²⁹ When the objectives of the analysis include the impact of the company on the national economy, an analysis of the post acquisition phase will still be necessary (see Section 5). In this case the acquisition would not truncate the relevant entity's phase **sequence**; it would only terminate the existing phase

dependence on an OEM agreement in "Phase 2" to a greater variety of modes of marketing, less dependence on any one market agent and a gradual incorporation of "direct selling\servicing" in Phase 3 and beyond could be understood in terms of a strategy of *building a large, Israeli global company*. Alternatively, exploiting initial successes in marketing the product, etc in order to subsequently sell the company to a major foreign multinational might reflect a company basic outlook or strategy of "building a company today for selling it tomorrow". Note that the different strategies imply substantially different phase-sequences.

The above examples--which reflect a central difference among some of the Very Successful Data Security companies--illustrate two very important points. First of all, there are strong *feedback links between strategy(thinking) and actual behavior ("doing", phases)*; second, firm strategy may reflect *the preferences and outlooks of its founders*. Evolutionary feedback links like those between strategy and phases are commonly known in other areas for example when characterizing specific innovation processes within companies (the so called "learning perspective" in contrast to a planning perspective where the targets of development are either obvious or set independently of the actual implementation--See Imai et al 1988). Concerning the latter point it should not be surprising since entrepreneurs' actions may be motivated by a strong quasi-ideological component which may lead founders to aim at building strong indigenous companies rather than simply 'making money'.³¹ Some of the differences between CheckPoint and Aladdin on the one hand and Memco and *Com15* on the other may derive from these differences³².

3.4 Dynamic Elements in Sequential Causation

A look primarily of the *very successful* (SS) cases would show some of the mechanisms for Sequential Causation. In what follows we distinguish them according to phase of company growth.

³⁰ This would be important in periods of rapid change in markets and in technology. In our case, the rise of the Internet and the growing importance of the US market in Data Security products have triggered changes in strategy and the initiation of a new phase in their growth(an example is Aladdin).

³¹ We believe that entrepreneurial motivations could include "self realization" through actions such as the building of global companies. Monetary rewards are important but they are no less proof of having attained such objectives than being an objective in themselves.

³² There are probably more successful and less successful strategies and sometimes these may be easily differentiated. It may be however much more difficult in our case here. Success or Failure depend very much on objectives

Phase 1-Product Development

1. In three (3) out of four (4) cases either an OEM agreement with a major player in the field or an agreement with a major customer seems to have been an important factor in enabling the subsequent growth of the company.³³ The point to mention here is that such agreements not only assure access to market\client related resources (or enable sales in the short run) but also generate high impact intangibles such as credibility\reputation in the eyes of customers, investors and potential partners. They also provide cash flow and relative stability of this flow. This is very important for small, young companies in a world of great uncertainty. The agreements also enhance the reputation of the company and its valuation.
2. Having a name in the market (through recognition of quality and efficiency of first product launched) is a precondition for an IPO. Both Check Point and Memco fit this case, in both cases IPO came very fast after foundation(3-4 years). This is a main difference between a high-tech Start-up and a regular company. Note that not any firm has a potential for generating such reputation in the early years: it very much depends on the innovation considered and on the background of entrepreneurs. Check Point's Firewall was a new product class which satisfied an important need; and the company created a new market.

Phase 2-Market Penetration and Broadening of Product Line

3. IPOs compel companies to define a focus and strategy and pave the way for Market Penetration (and Consolidation). This occurs through a number of mechanisms-- enhanced reputation; enhanced credibility and visibility viz a viz customers; availability of cash and equity with which to undertake M&A2 (Memco case); etc. In some cases (Aladdin, Memco) it is part of an *explicit market penetration strategy*.
4. While the M&A1 alternative for Market Penetration\Enterprise Consolidation might be relevant in some cases³⁴there may be significant differences in terms of

³³ OEM agreements played an important role in the case of CheckPoint and Memco while an agreement with a major customer did so with NDS. No clear information about such an early high-impact agreement exists in the case of Aladdin and this probably reflects the different *industry stage* when this company was active in the early years after foundation. Thus, marketing to Europe probably involved lower critical mass than relative to what was required during the 90s (*middle industry stage*) for Memco and CheckPoint to start selling in the US market.

³⁴ M&A1 was a relevant alternative for Algorithmic Research's US market penetration strategy during the first half of the 90s. It adopted a dual strategy of considering both alternatives IPO and M&A!. In the process of preparing for an IPO it chose to be acquired by Cylink when the opportunity arose.

"asset accumulation" or "access to assets" under both strategies. A successful IPO may have strong dynamic effects at the cost of large time and money investments in the short run. A successful A&M1 on the other hand may provide strong advantages in the short run (access to the market\customer related assets of the parent company)but may also entail a shift from indigenous accumulation of market\client related assets to 'access' of such assets (through the 'parent' company) a fact leading to lower dynamic effects.³⁵ Alternatively, it may entail a truncated *Innovation* Capabilities trajectory and its substitution by a narrower *Technological* Capabilities trajectory with weaker asset accumulation and less relevant spillovers to the national economy.

Pertaining to Two or Three Phases

5. Early links with key customers paves the way for subsequent Acquisitions(M&A1). This is clearly the case of NDS(Phase1) and Memco(Phase 3). In both cases the time taken for this dynamic effect is very short, in the case of NDS it seemed to be almost instantaneous; maybe two or so years in the case of Memco. The prior link could be an OEM link (Memco, although Platinun had also invested in the company) or a principle client(apparently the case of NDS with Sky).
6. The growth of all successful companies involves a change in the mode and structure of marketing and clients with strong inter-phase and feedback effects . In the case of Check Point for example we observe a shift from OEM and large reliance on one customer (Sun); to greater customer diversification; to greater diversity of marketing modes(resellers, etc); to an element of direct sales. Each sub-phase must have involved significant asset accumulation especially enhanced credibility & reputation and enhanced links with & knowledge about customers\marketing agents.

3.5 Specific Aspects of Strategy

We will systematically be using materials from 3 firms and fragmentary evidence from another 6. The focus is on 'pure strategy' rather than on a mix between

³⁵ The desirability of accumulating indigenous assets in connection with marketing\clients etc depends also on whether or not well functioning markets exist for these "complementary assets". Since the latter are at most imperfect at least a measure (and probably a great deal) of indigenous accumulation would be required for those companies choosing an indigenous consolidation strategy.

sequential causation and strategy(as was in previous subsection. There are several dimensions which we outline below, one at a time.

1. *Preferences of founders:* A distinction between 'creating a company in order to sell it' or having an objective of building global companies has been noticed(CheckPoint & Aladdin versus Memco). The option is very real now given the possibilities of selling companies. One company founder has said explicitly that his objective was to sell(this happened after the interview). In others it is a mix between preferences and outlook--the view that in this period of consolidation of the Data Security area there is no alternative than to be merged or acquired by larger network companies(Memco). In some cases (e.g. *Com10*) being acquired by another company was directly related to penetration of the US market; another option which was seriously being considered and in which the firm had considerably invested in was IPO(a motive of being acquired for marketing reasons also seemed to be the case of NDS). Finally we should mention the case of *Com1* where its acquisition by a large US company was not the result of its own preferences or strategy but the outcome of its parent having been acquired by such a company.
2. *Scope of Product Line:* The need to offer integrated solutions is mentioned by many companies in line with the increased networking requirements of companies (although *Com10* has mentioned this independently of trend), but the breadth of this differs from company to company. Memco strongly emphasizes the need of offering security products together with network\networking products; much less so CheckPoint, who is relying on a process of standardization to assure development of interoperable elements in the Data Security area.
3. *Non-Marketing Market Creating Functions:* One possible basis for an Indigenous Consolidation Profile (suggested by Check Point) is undertaking non-marketing 'market creation functions' side by side with marketing of new products. Its interoperability standards efforts at OPSEC are a case in point. Note however, that not all firms and all 'first products' can set the base for such efforts. On the

other hand, such efforts may be the critical ingredient which may transform a 'major Israeli innovation' into a tool for creating a large, indigenous company.

4. Purchase of Other Companies:

In most cases M&A is part of the market penetration\consolidation process\strategy which allows for both this course of action and for 'organic' growth. It was followed by Aladdin (purchase of Com14 in two separate operations) in the latter case as part of achieving critical mass for market penetration; by Memco (1998 purchase of Com14 and NIT); and lately by Check Point. There are differences however in the timing and probably in intensity of this type of behavior (CheckPoint less so than Aladdin and Memco, at least until recently when it bought the US MetaInfo; no role in the case of NDS).

5. Strategic Aspects Associated with Marketing

5.1 Marketing Objectives: The Memco perspective seems to be to grow with client companies' growth and to offer integrated solutions. This means *a large measure of co-evolution with customers*. This is not the case, at least to the same extent, of CheckPoint and it doesn't seem to be the case of Aladdin, Com2, NDS, Com10 nor of any of the other companies. However both CheckPoint and Memco have felt very strongly the need of *accumulating marketing & client related assets (including. links, knowledge about their needs and strategy, credibility and reputation etc)*. In the case of CheckPoint there seems to be a relative shift in emphasis from technological to these other types of assets.

5.2 Target Customers: Several successful companies have explicitly targeted *large users\corporations*. So has Com11 which is an "emerging" "O" company. One company mentioned a "dynamic" implication of focusing on large customers: the reputation generated will enable them to shift easily to other customer segments later on³⁶

5.3 Components of the Marketing Strategy: Several elements are present in different combinations in different companies. It must be noted here that companies perceive that the problem is not only investment as conventionally perceived but also generating credibility in customers i.e

³⁶ Com10 is now attempting to penetrate other segments which are now becoming increasingly important.

frequently large corporate users(difficult to achieve for small Israeli companies)

- Aladdin's strategy for penetrating the US market included explicitly undertaking an IPO, as well as purchasing the anti-virus division of a local company (*Com3*).
- Check Point's strategy involved beginning with an OEM agreement and then proceeding to diversify agents and modes of marketing; and simultaneously initiating an active Standardization process by creating and heading OPSEC
- Memco's included a combination of sales through distributors and an OEM agreement. The agreement, which also involved a strategic partnership with Platinum, metamorphosed into an acquisition by the latter. This in turn should be viewed as part and parcel of the market penetration and company growth strategy.
- *Com2* strategy is two fold: participating in large, multi-firm networking projects; and active participation in the most important standards committees in the Security Area.

4.OUTSTANDING CASES OF SEQUENCING AND STRATEGY³⁷

We summarize stages and strategy of three very successful companies and of one non-successful one("O" group).

4.1 CheckPoint

General Aspects of Strategy

- *A long term perspective* can be seen throughout the history of the company.
- *Objective -Creating a "Real" Israeli Company*: Founder preferences\outlook parallels that of Aladdin's founder. Acquisition by another company(M&A1) seems to be ruled out, contrary to the Memco strategy(acquisition offers were not accepted).

³⁷ The purpose of this section is to illustrate, further specify and integrate our knowledge about phases and strategy (thereby arriving at *firm growth profiles*). Depending on his objectives, the reader may consider skipping part of it.

- *Continuos upgrading and diversification in Marketing*
- *Active Standardization Efforts*
- *Internationalization and HQ: setting up offices or subsidiaries abroad--yes; but leaving company HQ in Israel.* ³⁸

Phase 1(1993-95 approx): In the first phase(starting with foundation of the company in 1993) the product launched was the Firewall-1 and most sales went through an OEM agreement with Sun.

Strategic Aspects Phase 1

- *Strategic Waiting:* founders decided to wait a couple of years for the Internet would take off before establishing the company in 1993. Observers stated that the timing decision was right and "the company grew with the Internet".
- *A Major Innovation:* the company's first product(Firewall 1) was a "major" innovation(practically the first representative of a "new product class") which also *created a new market*.
- *Marketing:* Initially was done through an OEM agreement with Sun Microsystems(the clear potential of the new product made this possible. Not every company has the option of entering into an OEM agreement with a major player). Such an agreement is not inconsistent with the objective of building a global, indigenous company, on the contrary, it might provide 'breathing space' to build the assets of the company and to generate a capability to shift to other marketing modes in the future. A major issue is to what extent the agreement with Sun represented a 'mechanism of learning' for Check Point, no less than a 'sales channel'.

*Phase 2 (1995-9)*³⁹: Some widening of the product line (always software) through the launching of VPN-1⁴⁰ in 1995; an IPO in 1996; and diversification from Unix to NT. Related to the latter and since 5\98 there is a strategic relationship with Microsoft for network security and network management (the agreement is technological but may lead to marketing links as well). Also from the 'technology side' a clear strategy seems

³⁸ This is the model followed also by Aladdin. It also involves a particular way of managing and staffing overseas offices.

³⁹ This phase may have to be divided into two separate phases.

⁴⁰ VPN stands for Virtual Private Network which is use of the public Internet network to generate a network transmitting encrypted information linking the company with outside suppliers, customers and partners(as well as linking the employees of the company itself).

to be involved in the company's initiating OPSEC-Open Systems Security for Enhanced Connectivity (and industry standards committee led by Check Point to ensure interoperability between its and other security products).

This phase is also characterized by intense changes on the side of marketing and probably a much larger relative focus on Marketing compared to R&D (relative to what was the case previously). There is an increased role of resellers and of OEMs beyond Sun e.g. Nokia has lately become a substantial source. Sales through Sun went down from 40% of total during 98 (or 97\98) to 6% in 99 (or 98\99). All of this may comprise a sub-phase of enterprise consolidation.

Strategic Aspects Stage 2

- *Shift in the Marketing Mode Perspective*—the first mode of marketing would only set the base for subsequent modes which would be less dependent on Sun; more varied e.g. adding over 1000 distributors; and including an increasing element of direct marketing\support(1999). This accords with the idea of creating a global company.
- *Moderate increase in Product Line within the Data Security Area*: the company entered the VPN area (1995) and the Windows NT area (in mid 199?). This decision might be linked to an agreement with Microsoft for technological cooperation). It also acquired one US company in 1999 (MetaInfo) whose products were complementary to some of the latest products launched.
- *The company's strategy up to now seems to involve **not** to provide integrated solutions to customers* (maybe Value Added Resellers or distributors do some of this), certainly not in connection with linking Security with Network\Networking products. In this connection the company is only a software company and even in the security area itself only integrated solutions of moderate scope seem to be offered. It is contrary to the perspective and actions of Memco.
- *Active Standardization Efforts are a Mainstay of CheckPoint's Strategy*: the creation of and active leadership of OPSEC(Open Systems Security for Enhanced Connectiveness) has as an objective assuring interoperability among the various security products more specifically among products of member company's and those of CheckPoint. This required the company to have an open systems strategy and to be actively involved in generated interfaces between other company's products and CheckPoints' products.

- *Collaboration*: the scope of collaboration within OPSEC seems astounding-- over 200 companies are members including many Israeli data security companies.

Phase 3(1999-): Lately we see the development of new products (Flood Gate and Remote Link) and the purchase of the American company MetaInfo. This may signal the beginning of a more explicit A&M strategy if growth for the company. This company specializes in managing organizational networks and its product/products are complementary to Flood Gate. There are also the beginnings of Direct Sales which in most cases complement rather than substitute for marketing through resellers e.g. they could offer 24 hours a day, 7 days a week support which resellers in general do not offer.. There are also selected Enterprise Accounts where direct sales are undertaken for small number of large and potentially valuable customers.

4.2 Aladdin

Phase Sequence: General Aspects

The case of Aladdin is different since its phases are a result both of "asset accumulation"\sequential causation (with little environmental change) and 'major changes in the environment"(the need to penetrate the US market first; and to shift to Internet and Internet compatible products later on). This is the outcome of the firm having been founded in Stage A of the Information Security Industry(1985); and thereby having undergone Product Development and Market Penetration\Product Line Expansion already during the eighties and early nineties. The changes occurring during the nineties required that Aladdin undergo the above mentioned two major adaptations before entering fully into its Third Consolidation Phase i.e. penetrating the US market, with the IPO as a major mechanism during the first half of the 90s; and adapting to the Internet during the second half. The company is now poised for consolidation.

General Aspects of Strategy

- The founder and CEO had clear preferences to build an Israeli global company from the outset, which "would provide real solutions to real problems". (NOKIA is a model for Aladdin today). There was no objective of "creating a company today in order to sell it later".
- Bootstrapping was also part of his initial perspective--in order to preserve independence in decision making; to avoid pressure to sell to foreign companies

(pressure e.g. from VCs); and because in this way a company becomes self-reliant from the beginning and there are strong learning effects.⁴¹

- The process of internationalization involved leaving the company HQ in Israel and opening a US subsidiary managed by Israelis but manned by Americans.⁴²

Phase 1(1985-1990) and Strategic Aspects: The company provided previously unavailable software security solutions and marketed its products to Europe (not to the US, which would have required much larger entry costs). There seems to have been two strategic aspects or decisions: first, to enter the European market rather than the US market; second, to actively pursue a policy of Mergers and Acquisitions (M&A2) to achieve critical mass for market penetration. This was only materialized in Phase 2.

Phase 2(1990-96):

During 1990-91 it became clear that penetrating the US market required a US presence so an office was set up after a difficult decision which entailed taking large risks (and investing 0.5 M \$). The company also entered into a partnership with a local representative.

In 1992 a US subsidiary and distribution system was created. Still the US competitor of Aladdin (*Rainbow*) dominated 90% of the market due to the (low)credibility of the company.

This led to the IPO in 10\1993. The objective was not to acquire resources\cash, but to push sales to large companies since a successful IPO would generate greater visibility and credibility . Sales grew significantly after the IPO. The also considerably reinforced the management team: CFO, VP for Sales and Marketing, VP for Business Development.

In 1995 Aladdin acquired a division of Eliashim.

In 1996 Aladdin merged with its German competitor (FAST).

Strategic Aspects-Phase 2

- The market focus shifted to the US in the early 90s not only in terms of size but also in terms of identifying emerging trends. Market penetration however was risky due to setup costs which were high relative to company size. A decision was taken to proceed. Subsequently an IPO in Nasdaq was undertaken as well as part of the overall market penetration strategy. It enhanced company credibility to customers(the cash and shares would also enable future investments in market penetration);

⁴¹ It should be noted that when Aladdin was founded in the mid 80s there was no Venture Capital segment to speak of in Israel. The company however did not actively request for OCS support either (which was readily available at the time).

⁴² There are strong pressures to shift company HQ to the US as part of the process of penetrating the US market.

Phase 3: In 1998 the company entered the Data Security area and purchased, the remaining unit of *Com3*. It then started developing the e-token product. The division purchased operates like a SU within Aladdin. The company also created subsidiaries in Holland.

Strategic Aspects-Phase 3

- Aladdin made strategic decisions to adapt itself to the changes brought about by the Internet. Since 1997\98 we observe a shift of existing (software security) products to be internet-oriented; as well as a decision to enter the data security area which had developed with the Internet (this led to the acquisition of *Com3* which is the E-safe division within Aladdin).

4.3 Memco

General Perspective

Founders believe that trends in the market require that company consolidation involve being acquired by a large software/network company. While it may also be linked with at least 'neutrality' with respect to the choice of building an indigenous global company or selling out to a foreign company--it is not a simplistic perspective at all. It involves deep knowledge of evolving customer needs and appreciation of the need to accumulate customer-related assets (at least till acquisition by another company)

Phase 1 (1990-93): Comprised the period since foundation of the company to 1993 when the company completed the development of its main product, SeOS . The company did "security" consulting initially and thereby got to know the market. This then led to product development.

Phase 2 (1993--1996) Penetrating the main Markets: In 1996 a Strategic Alliances and an OEM\ sales agreement was signed with Platinum. They also undertook an IPO once their product (the SeOS) had a name in the market ("we had entered large firms' playing field-based on the SeOS").

Strategic Aspects, Phase 2

- A focus on *large customers*. This meant competing head-on "in the playfield of leader companies";
- There was a shift over time from the objective of "marketing the product" to "*continuously satisfying the needs of your target customers*". This is a major shift, presumably not common to many companies, maybe a hallmark of

successful ones. It implies that one of *the major assets of a company is its links with and knowledge about customers*.⁴³

- The above in turn meant (as the networking process proceeded in the market place) "*providing integrated solutions to your customers*". The meaning would seem to involve embedding 'security solutions' into broader 'network\networking' solution⁴⁴;
- A mix between distributors & OEM agreement with a large company was used

Phase 3(1997--1998) Consolidation by Acquisition(M&A1): The third stage involves two outstanding events: Memco acquisition of two companies--Abirnet(Israel) and NIT(US) which reflects a strategy of growing not only internally but also through acquisitions; and acquisition of Memco by Platinum (M&A1, and through acquisition of this company by Computer Associates). The company is beginning a new phase as part of the larger US conglomerate. It is today a unit of the Security Division of Computer Associates; and it has not independent marketing.

Strategic Aspects, Phase 3

- Over and beyond any founders' preferences, it became clear that successful growth, given the above perspective, involved both purchasing other companies and being acquired by larger players (the larger 'networking' or software companies). Both took place.

4.4 Phase Characteristics of a Non-Successful ("O") Company

Phase 1, (1995-97): The Company was founded in 1995 and received support in the context of a special government program for two years. At the end of the period it had already a product\technology which could accelerate all the available encryption algorithms. During the period the activity was directed to prove the applicability of the technology and it underwent all the feasibility tests and proof of compliance with standards. The founder of the company worked part time at his company and part time at the Academic Institution where the product idea had emerged.

Phase 2, Managerial Crisis (1997-). In 11\97 the company started to act as a private company. There was a change in the target of technological development in response to feedback from the target market and from customers. Their main activity shifted to

⁴³ This is a major difference from the conventional view of the innovation process (including the proposition that "the new product should be adapted to user needs") which excessively focuses on technology. It is also at variance with the more conventional view of the innovating company and its assets.

⁴⁴ This would frequently involve offering solutions which mix both software and hardware.

product design and to marketing (rather than proof of applicability of the technology)- but this did not lead to sales (agreements were signed with two companies, one of them specifically for sales)

The period was marred by a CEO crisis which generated delays in obtaining the first round of VC capital. It also created a crisis of confidence with investors who then focused in salvaging what could of the investment rather than in furthering development of the company.

The case of *Com12* might help us trace one model of company failure (or non-success). From our interview there are a number of features which might have characterized the history of this company and which may explain its performance. We are not in a situation to confirm the truth of all of them but there is non-insignificant probability that they have occurred in some form. These include the following

- Phase 1 involved technological development of the idea brought from an Academic Institution with little or no contact with potential customers and with little or no search/research for potential product options prior to the selection of a particular design
- There are management issues in both phases (the company is still in phase 2) - part time commitment of founder during the Initial phase; choice of inappropriate manager during phase 2; and --as of late-- re-instatement of founder as CEO of the company.

The Innovation process would seem to have been "too linear and Government support may have reinforced the founder's instinctive bias towards "technology push" and the linear model. Non-success is clearly related to "management" (although we have no way of assessing the potential of the "invention").

5. THE SOCIAL IMPACT OF ALTERNATIVE VERY SUCCESSFUL COMPANY PROFILES

The variables influencing the social profitability or social impact of a firm are classified into four main categories: private performance; employment effects; cluster effects; and (for firms having been acquired by a foreign company) characteristics of the post-acquisition phase. Our analysis will only be temporary since important

conceptual elements and data are missing. For our purpose each of the four very successful cases represents a special profile of growth.

The various elements of social profitability or impact are shown below.

I Private Performance

The extent by which the firm was successful in product and capital markets, as spelled out in Section 2 above.

II Employment Creation

Direct and indirect employment effects, not only of R&D personnel but also of non-R&D personnel.

III Cluster Effects⁴⁵

"Cooperation"

- (a) Cooperation and Coordination with other Israeli Companies
- (b) Investments and Acquisitions in Israel

"Spillovers"

- (c) Managers spinned -off from the company (and operating with other Israeli companies)
- (d) The contribution to other companies of Spillovers of Technology to other companies in Israel(including through turnover of personnel)
- (e) Demonstration Effects pertaining to Organization, Management and Strategy (including knowledge\information spillovers). This includes -as an extreme case of positive impact-proving that it is possible to create global, indigenous companies.
- (f) Incubators of skills, both technological and other, with strong effects on other companies of the area or in hi-tech more generally;

⁴⁵ We group the domestic "cluster\sub-cluster effects" generated by our successful companies into three main categories: "cooperation" which purports to include informal and formal cooperation, investment, coordination and acquisitions; etc: "spillovers", generation of "intangible public goods"; and "other". This list is adapted to our needs now, it is not complete, and it does not refer at all to 'cluster effects benefiting the company' .

Table 4a: Social Impact Scores⁴⁶				
<i>Company</i>	<i>Score</i>	<i>Employment Effects</i>	<i>Private Performance</i>	<i>Cluster & other Effects</i>
<i>Check Point</i>	14.6	5	5	4.6
<i>NDS</i>	10.6	4	4	2.6
<i>Memco</i>	10.5	4	3	3.5
<i>Aladdin</i>	10.8	3	3	4.8

Table 4b: The Composition of Cluster Effects						
	<i>Cluster & other Effects (indigenous companies)</i>			<i>Cluster & other Effects (After Acquisition)</i>		
<i>Company</i>	<i>Cooperation</i>	<i>Spillovers</i>	<i>Public Goods</i>	<i>Cooperation</i>	<i>Spillovers</i>	<i>Public Goods</i>
<i>Check Point</i>	3	5	5	-	-	-
<i>NDS</i>	3	3	2	3	3	2
<i>Memco</i>	4	5	4	3	3	
<i>Aladdin</i>	5	4	5	-	-	-

⁴⁶ The Cluster & Other Effects of NDS and Memco are based on 50% of the score for the pre-acquisition phase and 50% of the score for the post-acquisition phase.

- (g) Contribution to a culture of openness, to personal networks and to collective learning about technology, management\organization, and strategy.

" Public Goods"

- (h) Enhanced credibility of Israeli Data Security Firms in the eyes of Foreign customers
- (i) Availability of marketing and client related assets which have (or potentially may) benefit other Israeli companies
- (j) Enhanced country (or Hi Tech sector) reputation which the operation of a company may generate⁴⁷
- (k) Contribution to the creation of Industry Specific Public Goods (e.g. standardization, training) or to the organizations\institutions generating them.
- (l) Contribution to the creation of "New Institutions"(e.g. changes in the Encryption Decree)

"Other"

- (m) Reinvestment of M&A1 proceeds in Israel (an "income cycle" effect)
- (n) Contribution of company to Critical Mass of People or Companies(especially during cluster *creation* phase or early stage of Information Security sub-cluster); etc
- (o) Contribution to the Implementation of New Policies benefiting the sub-cluster or the hi-tech cluster.

IV Favourable Features of Post Acquisition Phase⁴⁸

- degree of independence in decision making;
- whether the ex-Israeli company has an independent marketing capability
- whether development efforts in Israel have been enhanced;
- whether R&D personnel maintain contacts with customers abroad

⁴⁷ Contribution to solving the "Israel Problem" which diminished the disposition of foreign companies, agencies, investors, individuals to transact with Israeli companies(this was strong during the 70s and 80s).

⁴⁸ Relevant only for companies having undergone M&A1. The aspects listed have a lot to do with the Cluster effects listed for the pre-Acquisition phase.

- whether Israeli managers occupy important positions in the merged (or foreign acquiring) company; etc

Needless to say we have not developed yet indicators for these variables (this would be a project in itself) nor ways of creating an index of social impact. Despite this we have tentatively ranked the four very successful companies-CheckPoint, Memco, Aladdin and NDS-- in connection with each one of the three categories ("cluster" and "other" effects were lumped together). The range for each one is 1(weak effect)--5(strong effect). Table 5 summarizes our results⁴⁹.

To get an overall index we simply add scores for each one of the last three columns of the Table(upper part): Private Performance, Employment Effects and Cluster & other Effects. The outcome ranks CheckPoint first(14.6 points out of a maximum of 15), Aladdin second(10.8 points) , Memco third and NDS last(around 10.5 points). These numbers are for illustrative purposes only and therefore should be taken with a grain of salt, to be improved in further work. To counteract our own biases we have purposefully under-estimated the Key Agent effects of indigenous companies like CheckPoint and Aladdin, in particular their enormous contribution in generating the option of "indigenous, global Data Security company" and in the case of Check Point, an "indigenous model" for hi-tech in general. The NDS score depends on whether the cluster effects on the emerging Jerusalem cluster were important (it seems to have contributed to the critical mass of people and companies there) and whether it is important to generate a hi-tech cluster in Jerusalem.⁵⁰The points assigned to Memco for its post-acquisition phase (last three columns, lower part of table 5) are based on the assumption that this company will not in the future have an independent marketing capability and that its direct contact with customers will be limited.⁵¹

Preliminary Conclusions

1. There are a *variety of growth profiles* of companies which may make a significant social contribution to the economy. Our preliminary conclusion is that *each one of*

⁴⁹ The scores of "cluster and other effects"--last column of upper table--are based on the figures in the lower table of the figure. The first three columns of that table correspond to indigenous companies; the last three for companies acquired by others. For indigenous companies (foreign subsidiaries) the score is obtained by adding the figures in the lower table and dividing by three (by six).

⁵⁰ This emphasizes the point that the social contribution of a company may depend on the "strategy" of the economy and more generally on national objectives.

the very successful companies has made a significant social contribution to the economy and high tech cluster, both those having been acquired by foreign companies and those having followed the indigenous consolidation profile.

2. In our opinion, at least three *cases of privately successful companies acquired by foreign companies who had strong social impacts*: Memco & NDS; and Com10("S" group). Memco made important contributions in terms of cluster effects (cooperation with other Israeli companies; investment & acquisitions in Israel; and expected reinvestment of proceeds of sale to Platinum(CA)). NDS has increased its R&D effort, has experienced a healthy growth in employment and has contributed to the emerging Jerusalem Hi Tech Cluster. Com10 reports a favorable post-acquisition configuration- has kept its own marketing effort; has a mandate (for the time being at least) to market in Europe; and key personnel occupy positions in the board of the acquiring company.
3. It is *wrong to adopt simplistic distinctions* such as "Company that remains Israeli--Good"; "Company acquired by a Foreign Company--Bad". Such distinctions are not consistent with this era of globalization. We have shown that acquired companies may still make important contributions. On the other hand privately profitable Israeli company may, in principle still have very little impact on the national economy--few spillovers and weak employment effects throughout the economy. Finally we must remind ourselves that in some areas, due to scale effects of various kinds, healthy growth and consequent high potential social impacts may depend on having or having not merged (or being acquired) by a leading player in the field.⁵²
4. Having said that, *our presumption is that in a large number of cases relevant for Israel the social impact of companies having followed an indigenous growth path is potentially higher than those having sold out to foreign companies*. As mentioned the mere fact of generating an 'indigenous, global company option or model' is very important, especially if differential effects could be expected between indigenous and acquired companies. This of course requires strong initial conditions (significant innovation and excellent entrepreneur backgrounds--see Section 6); a favourable environment for business in the country(including

⁵¹ This may or may not turn out to be true. However today after its acquisition by Computer Associates, Memco does not undertake marketing as it used to.

⁵² Thus the issue of remaining an indigenous company or not is not only a question of founders' preferences but also of the specific contexts surrounding the evolution of companies.

policy); maybe a pre-existing cluster or hi tech sector; and luck. Check Point has made an enormous contribution through its own performance and through very strong cluster effects; while Aladdin among other contributions has both played an important role in the emerging new hi-tech cluster of the nineties and in showing that an indigenous phase sequence is possible and profitable. The importance of a "balanced accumulation of assets" cannot be discounted: indigenous companies who are successful must accumulate market and customer related assets in parallel with the accumulation of technological assets. These assets then become, to some extent, part of the 'national pool' and other companies and the whole cluster could benefit.

5. *A healthy Israeli hi-tech cluster (and Data Security sub-cluster) would strongly benefit from having an increasing number of (Israeli) "global" companies such as CheckPoint and Aladdin.* This follows from the fact already mentioned that such companies would tend to have strong cluster effects. More specifically they are models of growth which domestic firms will emulate⁵³ and incubators of skills which benefit other companies. The two companies mentioned above (and Memco to some extent, till its sale to CA in 1999) were the first of their kind in the Security Area and "have shown the way". Other cluster effects came through the acquisitions of Aladdin and the enormous network of cooperation of CheckPoint through OPSEC (which other Israeli companies such as Com15 etc have benefited). Both companies potentially will generate extremely important cluster effects in particular, spin-offs of experienced personnel which will contribute to pull other companies upwards. In general we may say that having "relatively large" indigenous companies could provide stability, critical mass for R&D leverage in global markets, as well as being incubators of skill to the local hi-tech cluster.

6. BACKGROUND AND EXPERIENCE OF THE ENTREPRENEUR\CEO - LINKS WITH PERFORMANCE

⁵³ When highly successful global indigenous companies are rare they are almost inevitable 'models' for other companies and through this may contribute to a new cluster configuration involving a greater representation of 'large, indigenous companies'. Our thesis is that while foreign multinationals would play very important cluster functions during the very early phases (this was true in both Israel and Ireland), these functions at a later stage will be taken over by successful, global, indigenous companies.

The main distinction relates to the types of background and experience of the entrepreneur and/or CEO of the company⁵⁴. We have made the following distinctions:

- Computer Hobbyist
- Army
- Company Experience
- Consultant
- University

We also distinguish between entrepreneurs having a mix of different backgrounds-- *Multi-Element Background*-- from those having one type of background exclusively. Our sample includes 14 companies out of 19 Information Security firms, which includes all of the (privately) successful cases and four (4) companies of the non-successful "O" group (two "emergent", one "failed" and one "struggling"). We observe three (3) cases of *Multi-element Background* and four (4) cases of founders (or 'founding team' with at least one member) who were *Computer Hobbyists*-Check Point, Aladdin ("SS" group) and *Com14, Com15* ("S" group--See Table 6). Founders here were young when their companies were founded.

An *Army background* means that the founder or CEO spent time or worked in Israel Defense Forces-- in areas such as computers (either Mamraam or in other organizational units) or the Information Services-- where experience with data processing, data security and networks' issues was accumulated. In some cases the experience was general and only touched upon tangentially the specifics dealt with later on in their companies; in other cases, the idea for the first product developed by the company first arose in the Army and even could have been first applied there. The paradigmatic case of an extremely relevant Army background and experience was the case of Check Point, but there are other cases where the background was extremely important even though the specific idea/prototype did not arise there (Memco & *Com14*). Table 6 records only these three cases as reflection of founders with an *Army Background*. Three other cases where such background was more general or weak were not defined in this way (*Com15, Com1, Com14*).

⁵⁴ We generally don't have information on both. In all cases but three the information refers to the founder/entrepreneur (in the remaining cases the information refers to the current CEO). In two of these (*Com1 & Com2*) there is no clear founder since the companies are subsidiaries of a existing companies.

Company Experience includes a number of aspects: having founded another company previously (case of *Com14*); ;having been a manager of other companies(*Com7*); having worked in marketing in another company(*Com11*); having worked in development in another company(*Com2, Com14, Com11*); being involved in consulting immediately after company foundation(before getting involved in product development--cases of Memco & *Com14*); some cases when the company was a subsidiary of another company(*Com2 & Com1*).⁵⁵ In a broader study it will be important to consider also the types of firms where founders have been employed as well as the geographical location of their pre-foundation experience. For example there are cases where founder marketing experience in the US was a background factor having an impact in new companies whose market was the US(e.g. RadNet in the Communications area). Having a Company background is a widely held characteristic of firms among all three categories.

The next to last category of background and experience which arose in the interviews was *Consultant\ Consultancy*. This involves either founders spending some time prior to the creation of their companies as free lance consultants to other companies on security issues(e.g. *Com5*) or on other broader IT areas(e.g *Com15*); or as mentioned previously, the company initially was involved in data security consulting(Memco).

Finally a *University Background* should be distinguished from an Academic Degree. It involves founders who have been involved at Universities doing research\teaching or pursuing second\third degrees. Two cases are recorded in our sample of 14 companies-NDS ("SS") and *Com10*("S"). In both cases the university background involves experience with the area where the company will be involved and in some cases application of technology\knowledge developed at an Academic Institution.

Founding Team

The second distinction relates to whether the founder was one individual or a team of three or more; and whether the initial team of the company was assembled from the institution\organization where the entrepreneur worked prior to founding the

⁵⁵ Only when there is a strong link between the technology\markets of the parent and of the subsidiary would we classify the 'founder' as having prior 'company experience'. In one case for example, the need for the subsidiary's product arose from customers of the parent company. This led to create the subsidiary.

company. A total of 7 cases with a "founding team" were recorded : three SS, three S companies, and one "emerging" O company(Tables 6,7).

Academic Degrees

The third distinction refers to whether the founder has or does not have an Academic Degree, and whether it is a Technical Degree (an Engineer) or another degree e.g. an MBA. A total of 8 cases were recorded: two SS, three S and three (out of four sampled) O.

**Table 5a: Background of Entrepreneur/ Founder of
“Successful” Firms (and “Nature Team”)**

<i>SS-Group</i>	Multielement	Hobbyist	Army	Company Background	University	Consultant	Academic Degree	Team Y/N
CheckPoint	✓	✓	✓	✓			✓	✓
Aladdin		✓						?
Memco		?	✓	✓		✓*		✓
NDS			?		✓		✓	✓
Sub Total (%)	25%	50%	50%	50%	25%	25%	50%	75%
S-Group								
Com10					✓		✓	✓
Com14	✓	✓	✓	✓			?	
Com2				✓**			✓	✓
Com15	✓	✓	?	✓		✓		✓
Com1			?	✓**			✓****	
Com3			?	✓		✓*		
SubTotal	33%	33%	16%	82%	16%	33%	50%	50%
Total (S+SS)	30%	40%	30%	70%	20%	30%	50%	60%

* -- Early company

** -- From Parent Company

*** -- Background of Current CEO

**Table 5b: Background of Entrepreneur/ Founder of “Other”
Firms and “Nature Team”**

<i>O-Group</i>	Multielement	Hobbyist	Army	Company Background	University	Consultant	Academic Degree	Team Y/N
Com5		?	?	✓		✓	✓	
Com11				✓			✓	✓
Com7				✓			?	
Com12					✓	✓	✓	
Sub Total (%)	0%	0%	0%	75%	25%	50%	75%	25%

**Table 5c: Comparison Between Successful (S,SS) and Four
Non Successful Firms (O-Group)**

	Multielement	Hobbyist	Army	Company Background	University	Consultant	Academic Degree	Team Y/N
Successful Firms	30%	40%	30%	70%	20%	30%	50%	60%
Non Successful	0%	0%	0%	75%	25%	50%	75%	25%

Summary

- *The most successful company(CheckPoint) was founded by a team of young individuals having an rich background as Hobbyists, in the Army, and also a Company Background. The team included at least one holder of an Academic Degree.*
- *There seems to be no significant differences between the S and the SS group of companies as far as Founder Background, Academic Degrees and Founding Team is concerned--the main difference being between Check Point and the rest. However, an Army, a Hobbyist and a Team Background (Company Background) characterized a higher percentage of SS (S)companies relative to S (SS)companies;*
- *The major distinction seems to be between the SS and S group on the one hand the O group on the other⁵⁶. There are four main differences*
 - *The importance of a Hobbyist background in the successful groups*
 - *The importance of the Army background in the successful groups*
 - *The multi-component background which is present in several S,SS companies and is absent in the others*
 - *The founding team factor present in the 60% of the success(and very success) full group and in 25% (one company) of the sample of non-successful companies.*
- *Neither a prior Company Experience, University Background, Consulting Background nor an Academic degree differentiates between the successes and the non-successes. Note that prior Company Background characterizes about three quarters of both groups while having an Academic Degree characterizes the founders of half of the successes and about three quarters of the non-successes.*

⁵⁶ The following is based (as previously) on full information about the success(and very success)full companies and on four (4) non successful companies. But in addition we have fragmented information on other non-successful information (which we have not put in the tables). Thus the significance of the following statements is slightly stronger than what it would seem from comparing the full sample of successful companies with only 4/9 of the sample of non-successful companies.

We might interpret the high frequency of both company backgrounds and of Academic Degrees in success and in failure as *necessary conditions* for success, but not sufficient. This could have a grain of truth but we must remember that in software development there is ample scope for Hobbyists and individuals with practical experience to succeed in creating companies even without having Academic Degrees.

A final thought is that the rich background factors characterizing successful companies are also indicative of *cluster effects* coming from the wider system into which entrepreneurs and company founders were *embedded*.

SUMMARY AND CONCLUSIONS

The main focus of the paper is the study of the emergence and development of companies in the Information Security area in Israel, since inception of the industry in 1985 to 1999. This responds to *two strategic priorities of Israel's System of Innovation and particularly its hi-tech cluster: a) enhanced effectiveness of the transition from Start-up(phase1) to subsequent "implementation" phases; b) to enhance the creation of hi-tech 'global companies'⁵⁷*. The procedure followed was based on a number of very 'labor intensive' phases in the research: definition of the boundaries of the industry and stages in its evolution, identification of the Universe of firms(19 firms), in-depth interviews of each company in the Universe, a survey of some companies(mostly for quantitative information, 14 forms returned), summarizing interviews, ascertaining (private) performance, identifying a *main sequence* of growth for very successful companies(which combines *phases & strategy*) as well as a *special case*, thinking about "social impacts" of alternative growth profiles, and studying characteristics of the entrepreneur. The most important conclusion is that *there is a certain generic pattern of growth of the four (4) very successful companies(CheckPoint, Aladdin, Memco, NDS) based on three relatively well defined phases-Product Development, Market Penetration, and Consolidation- although the specific profiles differ and so do the actual and potential social impacts*.

In the "main sequence" all companies successfully undertook IPO at the beginning of the second, market penetration phase. This IPO had a significant

⁵⁷ See Teubal, M.: "Towards an R&D Strategy for Israel", *The Economic Quarterly*, December 1999(Hebrew).

impact on the dynamics of company growth and on its subsequent performance. It set the stage not only for market penetration (the US market) but also for full-fledged company consolidation, a major factor being enhanced credibility and reputation in the eyes of actual and potential customers, shareholders, partners and suppliers. Consolidation refers to products, strategies, management and organizational forms—a situation enabling greater stability in sales, more knowledge about the types of uncertainty which may affect future performance; and a greater capacity to adjust and adapt. Two patterns of consolidation are here identified: *indigenous consolidation* (Aladdin, CheckPoint)—a pattern leading to higher actual and potential social impacts; and *acquisition by a foreign company* (Memco) which while also "socially profitable" has—and despite inherent conceptual and measurement difficulties in the 'social impact' concept—in all likelihood has not generate the same level of social impact as the former.

Similar 'social profit' considerations hold for the sequence termed *the special case* (NDS) where there are sharp differences in the pattern—market penetration (this time Europe) was associated not with an IPO but with the company being acquired by a large foreign multinational (M&A1) early in Phase 2. IPO is thus not the essential component of Phase 2 nor of the process of company consolidation in this case (although it may take place later on and for more conventional reasons).

Most importantly, the companies with an indigenous consolidation profile have played the role of *Key Agents* both in the emerging Security sub-cluster and beyond. Such agents play key roles in clusters or in the transformation of systems of innovation⁵⁸. In our case their role lies in a) showing a possible 'successful' model of indigenous growth that other companies could follow ("creating a new 'business model' option); b) one with large social impacts (e.g. positive "cluster effects" favouring other companies)—partly because of it being an 'indigenous' alternative to consolidation. More concretely Alladin and CheckPoint have shown that a path of "indigenous consolidation" with high 'social impacts' is both possible and privately profitable. Moreover, indigenous companies in certain contexts seem to have a stronger potential for "leveraging R&D" (which in the context of Israel, is the critical issue in "R&D Strategy") and generating high rates of growth of

⁵⁸ See Teubal & Andersen (2000) forthcoming.

value added to the economy as a whole⁵⁹. This in part derives from the fact that they generate a 'balanced' profile of asset accumulation which includes additions to the company (and national) stock of market\marketing & client-related assets.⁶⁰

The paper also shows that there are significant aspects of *company strategy* which underlie the difference between indigenous and foreign- acquired very successful companies. This starts with *founders' preferences* and more specifically whether the objective is or is not to build global indigenous companies 'who will provide real solutions to real problems'⁶¹ But it goes way beyond this for example the scope of product line enhancement perceived as necessary; explicit attempts to "create markets" which go beyond 'pure marketing efforts' (e.g. Check Point's leadership of OPSEC which is an interface standards committee); etc.

A second issue addressed in this paper concerns the "initial conditions" of companies in particular founders' background and experience. We distinguish between various types of background-hobbyist, army, company, , university, consultant; whether or not founders had Academic Degree, and aspects of the initial team. The major distinction is between very successful(4 companies) and successful companies(6 companies) on the one hand and non-successful companies on the other. Founders having strong hobbyist and army backgrounds are well represented in the former group and not in the latter group. Despite limitations in information concerning six (6) non-successful firms it seems that there are no significant differences between these two groups concerning founders' possessing or not possessing Academic degrees (most of them where in Engineering, some in Science, and one\two MBAs) and concerning Company background. Having an Academic Degree does not seem to be a necessary condition for success in the Software Information Security industry(this contrasts with the apparent situation in the Communications equipment industry).

⁵⁹ This, as we showed, does not mean that acquired companies will not have important 'social impacts'. Moreover, the above statement is a complex one and should not at this stage be taken as indicative of a complete conceptual framework about the "social impacts" of alternative company profiles in this era of globalization. Much more microeconomic and conceptual work of the type undertaken here is required for this.

⁶⁰ Beyond their role as 'key agents' very successful indigenous companies especially (but also Memco and NDS) have made substantial contributions to the information security sub-cluster and to the hi-tech, information technology cluster. These can be divided into "cooperation", "spillovers" , "intangible public or semipublic good", and "other" components.

⁶¹ Yanki Margalit, founder and president of Aladdin Knowledge Systems.

The analysis has strong potential policy implications which we will develop jointly with a sister report on "hardware" hi-tech, information technology sector--the communications equipment industry.