US Patent Filing By Israeli Companies

A Study by PG Technology Research

Introduction – Israel is called as the hub of technology innovation and entrepreneurship. It is considered that mandatory military service for both men and women has had a big impact on Israel's entrepreneurial culture. The military service provides young people with additional training and experience in a variety of technical fields which foster the attitude of entrepreneurship in them.

According to Forbes research, a large number of global companies are looking to Israel for new sources of innovation. Companies like Microsoft, Facebook, Amazon, etc. have set up R&D labs in the country to tap benefit from the brilliant minds. Many of these companies are adopting the concept of "open innovation" in Israel. They work with start-ups and mentor entrepreneurs – but with no strings attached [1]. In fact a large number of Israeli start-ups are being acquired by giant companies to integrate into Israel's innovation ecosystem. The public offerings and M&A deals of Israeli Hi-tech companies were whopping \$23.8 billion in 2017 [2]. Further, Israeli start-up companies raised a record \$4.8 billion in 2016, up 11% from \$4.3 billion in 2015 [3].

With increasing innovation, the urge to protect and get its full commercial value is also on the rise as evident in the patent filing trend from the country. The report shows some key statistics of patent filing activity of Israeli companies and institutes in United States.

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I. Year-Wise Patent Application Filing Trend

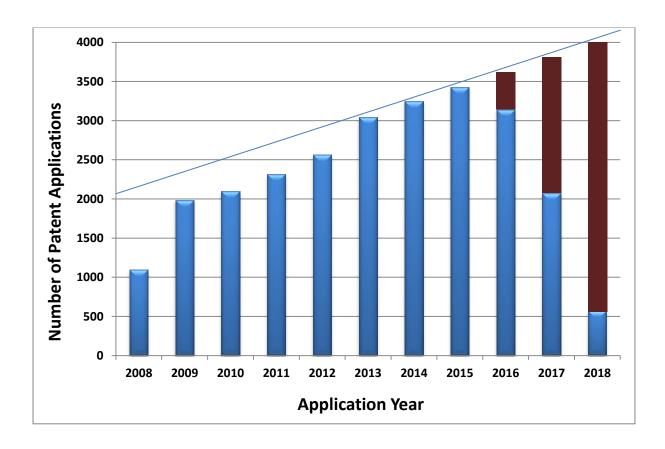


Fig. 1. Year-Wise Patent Filing Trend of Israeli Companies in US

Figure 1 illustrates the patent application filing trend of Israeli companies in United States from the year 2008 till August 2018¹. The patent filing demonstrates the continuous increase in the filing trend during the last decade. The evident drop in patent filing after year 2015 is attributed to the unpublished applications. Considering the previous growth rate, an extrapolation of graph for the year 2016, 2017 and 2018 (marked in 'Red') result approximately 4000 applications filing for 2018. This indicates a strong increase in patent filing by Israeli companies in US at annual growth rate of about six percentage.

The strong patent filing trend is attributed to heavy investments by Israeli companies and institutes in research & development programs. According to a study, Israel spends more on research and development as a share of its domestic resources than any other developed country. Its R&D spending rose to 4.5 per cent of Gross Domestic Product (GDP) in 2017 compared to 4.4 percentage in 2016 [4]. A comparison with 2.744 per cent spending by United States and 2.107 per cent spending by China in 2016 proves the fact [5].

Another factor which drives the Israeli innovation is its encouragement and favourable environment for start-ups. Israel is known to have largest number of start-ups per capita in the

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¹ The patent applications published till August 2018 is considered for analysis.

world. The government initiated various programmes, like Technological Incubators Program by the Israel Innovation Authority in 1991 and "Yozma" (Hebrew for "initiative") in 1993 for providing early-stage funding for start-up companies and individual entrepreneurs. These programs set up their funds to invest directly in small companies and provided strong mentorship to help the start-ups success [6]. Israeli Universities also have a significant role in promoting entrepreneurship among their researchers. Tel Aviv University, the Technion-Israel Institute of Technology and the Hebrew University are ranked among the top 50 undergraduate programs that produce VC-backed entrepreneurs, according to research by a US company "PitchBook" [7].

Start-up Nation Finder, a database of companies for enabling start-ups to find the relevant relationships, partnerships, and solutions, list around 6000 companies. The database empowers Israeli companies with exposure to millions of global visitors who are seeking great partnerships with the local industry [8].

II. Technology Trends For Patent Application Filing

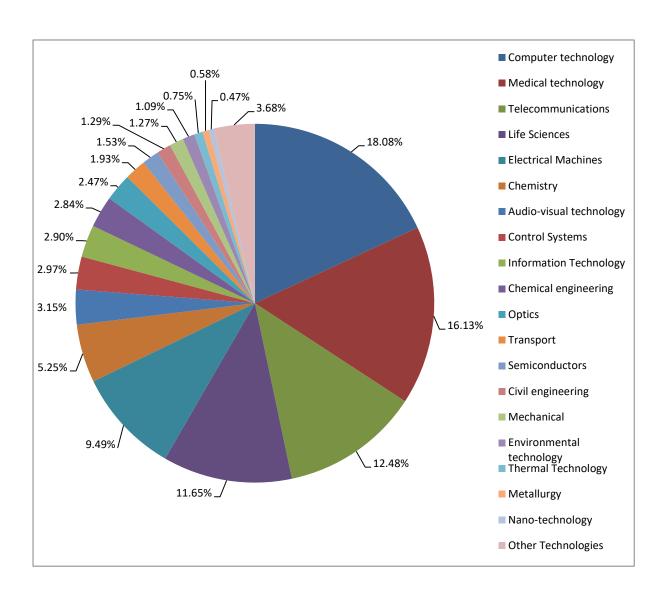


Fig. 2. Overall Technology Breakup of Patent Applications

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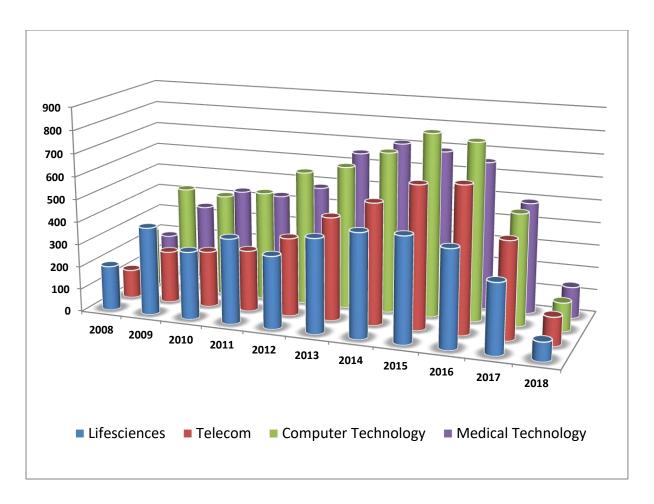


Fig. 3. Filing Trend in Technology Domains of Life Sciences, Medical Technology

Telecommunications and Computer Technology

Figure 2 illustrates the overall technology breakup of the patents filed by Israeli companies in United States since year 2008. Tech areas of Computer and Telecom share the major (about 31%) chunk of the patent filing by Israeli companies and universities in United States. Medical and Life Sciences also have a significant share (about 28%) in overall patent filing activity. The patent filing in the complex field of semiconductor is majorly done by companies like Tower Semiconductor Ltd., Solaredge Technologies and institutes like Technion – Israel Institute of Technology, Tel Aviv University, Weizmann Institute of Science and Hebrew University. NICE Ltd. is the largest patent filer of Information Technology followed by Vatbox and Cortica.

Figure 3 illustrates the patent filing trend in top technology domains² of Life Sciences, Medical Technology Telecommunications and Computer Technology. Barring a few discontinuities, patent filing in Life Sciences and Medical fields have seen an upward trend since 2008 indicating country's strong focus in these sectors. A slight dip in patent filing trend in 2015 as compared to the strong uptrend till 2014 could be, to an extent, attributed to the problems with Teva Pharmaceuticals which has seen a dramatic dip in US patent filing from 69 in 2014 to 27 in

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² Some of the patents considered for analysis falls in more than one technology domain. The data illustrated in figure 3 corresponds to all the technology domains of the patents.

2015. An article by Khen Elazar (https://seekingalpha.com/article/4063133-teva-pharmaceutical-negative-2015-still-negative-2017) speaks about the problems associated by Teva Pharmaceuticals. As a consequence of the financial woes, Teva Pharmaceutical Industries is planning to cut its workforce by more than a quarter, give up many of its manufacturing plants and suspend its dividend on ordinary shares in a much-anticipated overhaul to help pay off its debts [9].

Israel's Life Sciences sector is supported by some of the world's leading research institutes, renowned R&D facilities and cutting-edge medical centres. Over the last decade, Israel has introduced ground-breaking and valuable innovations in these areas. Global giants and top universities are working in collaboration with Israeli Life Sciences companies and institutes for research and development activities. Teva Pharmaceuticals has research and academic partnerships with renowned research centres like National Health Service (NHS) UK, Huntington Disease (HD) Network comprising researchers from Singapore, UK, Canada and Germany, and companies like IBM, Microchips Biotech, etc. [10].

As analysed from the patent filing activity, Israeli universities have jointly researched in pharma and medicine sectors and filed patents with global universities like Ohio University, Columbia University, University of Utah, University of Michigan, Institute of Microbiology Chinese Academy of Sciences, Kings College London, New York Stem Cell Foundation, Tsinghua University, etc.

According to a report by Israel Innovation Authority, the country has over 1400 Life Sciences companies, out of which 40% are in advanced stages and already generating revenues. As proof of the industry's development, in 2016 Life Sciences exports reached \$6.9 billion [11]. The life sciences sector employs 85,000 people, 2% of all employees in Israel, and is on a growth trend [12].

Telecom and Computer Technology have seen an almost upward trend in patent filing since 2008. The key filers in these sectors include Red Hat Israel, Marvell Semiconductor, SanDisk, Verint, Corning Optical Communications, Cortica, etc. which are also the overall top filers. Small-scale companies and individual inventors also have a significant role in innovation in these technology domains. A look at the Israeli tech scene, compiled by Israel's IVC Research Center (Source: https://www.timesofisrael.com/twenty-four-israeli-tech-firms-ripe-for-ipo-report-says/), for the heavily funded companies revealed a list of 24 companies [13]. Out of this list, only two companies, NovoCure and Gamida Cell, works in the Life Sciences sector while the remaining 22 companies are in tech field indicating the inclination of new-age entrepreneurs. The acquisition of Mobileye by Intel for \$15.3 billion is expected to further fuel the igniting tech field [14].

The analysis of patent filing activity also indicate that a large number of fortune 500 companies have established technology accelerators, incubators, corporate venture capital offices and R&D centers in the innovation country. Among those companies are Cisco, Intel, Google, Facebook, Apple, Broadcom, etc.

The significance of patent portfolio of smaller companies can be understood from the acquisition of LucidLogix Technologies by Google [15], 3D sensor company PrimeSense by Apple [16] and the acquisition of Mobileye by Intel [14].

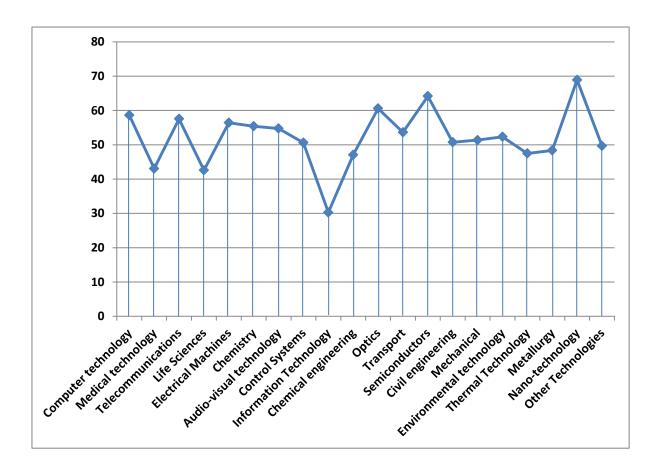


Fig. 4. Percentage of Granted Patents in Various Technology Domains

Figure 4 illustrates the percentage of patent applications filed by Israeli companies in last 10 years in United States which have been approved in various technology domains. The analysis does not take into account the unpublished applications. Overall, about 51% of the patent applications filed in last 10 years have been granted implying a very high degree of innovation. It also implies proper due-diligence of the inventions is being done through prior-art search and other methodologies to filter out potentially less relevant inventions. The high ratio of granted patents also implies quick conversion of an application into a granted patent, consequently implying less iteration during prosecution stage.

The graph shows highly complex fields of Nano-Technology (about 69%) and Semiconductors (about 64%) having impressive conversion rate of an application into a granted patent. The low patent filing and considerable grant rate in these domains imply highly concentrated and focussed research. The current 'hot' fields of Computer Technology and Telecom also have high grant rate (about 58%).

III. Filing Trends Of Israeli Companies

The list below includes the top Israeli companies actively filing patent applications in United States.

Table I: Top Israeli Companies Filing Patent Applications In United States

S. No.	Company
1	Red Hat Israel
2	Biosense Webster
3	Mellanox Technologies
4	Teva Pharmaceutical Industries
5	Marvell Semiconductor
6	Verint Systems
7	SanDisk
8	ISCAR
9	Corning Optical Communications
10	Applied Materials
11	Cortica
12	SAP
13	Solaredge Technologies
14	Israel Aerospace Industries
15	Mobileye Vision Technologies

As evident from the above table, more than 50% (8 out of 15) of top companies filing patent in Israel are headquartered in a different country. This illustrates the inclination of global companies to have R&D centres in Israel and churn innovations.

Amongst the above listed companies, Teva Pharmaceutical Industries, Mellanox Technologies, ISCAR, Cortica, Solaredge Technologies, Israel Aerospace Industries, Mobileye Vision Technologies are headquartered in Israel. These companies provide an interesting variety of technology domains; Mellanox Technologies — Telecom, Teva Pharmaceutical Industries — Pharmaceutical, ISCAR — Metallurgy, Cortica — Artificial Intelligence, Solaredge Technologies — Electrical Machines, Israel Aerospace Industries — Defence and Mobileye Vision Technologies — Optics. Teva Pharmaceutical Industries is listed on New York Stock Exchange and Tel Aviv Stock Exchange while Mellanox Technologies and Solaredge Technologies are listed on NASDAQ.

To highlight the interesting facts with one of these companies, Mobileye Vision Technologies was founded by Prof. Amnon Shashua (a researcher of the Hebrew University), who evolved his academic research into a technical solution. The company was acquired by Intel in 2017 for \$15.3 billion which is considered as the biggest-ever acquisition of an Israeli tech company. A major factor for acquisition of Mobileye by Intel was the fit between the patent portfolios of the two companies. Further, Mobileye's portfolio included key technologies in the autonomous vehicle value-chain [17]. The company is a fine example of entrepreneurship and start-up ecosystem provided by technology institutes of Israel.

Another company worth mentioning includes Cortica, which is a Tel Aviv; Israel based company working in the field of Artificial Intelligence. It provides the intelligence that enables autonomous vehicles, smart cities, and more. Remarkably, the company emerged out of a research project at Technion Institute, Israel. According to a report, Cortica is the top patent holder in US in the field of Artificial Intelligence [18].

Red Hat, Biosense Webster, Marvell Semiconductor, Verint Systems, SanDisk, Corning Optical Communications and Applied Materials are headquartered in United States while SAP is based in Germany. Interestingly, most of these US companies are either based in California or North Carolina. Only Biosense Webster operates in the domain of Life Sciences while other companies have their technology and products primarily in Software, Telecom and Semiconductor fields. All of these companies (or their parent company) are multi-billion dollars in worth and have set-up offices in Israel for technological advancement as evident from their patent filing trends.

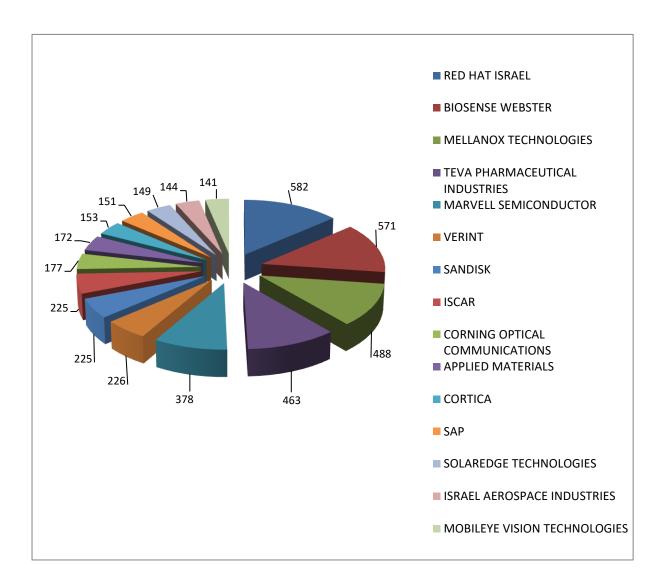


Fig. 5. Filing Activity of Israeli Companies

Amongst the top patent filing companies, only two companies, Biosense Webster and Teva Pharmaceutical Industries works in the domain of Life Sciences and Medical. However, these two domains constitute about 45% of the total patent filing by these companies. Computer Technology and Telecommunications constitute about 40% of the filings. The fact indicates the concentration of research in these areas which, not surprisingly, are also currently considered as 'hot' amongst the companies worldwide. In light of these findings, we may hope to have some ground-breaking innovations from Israel in these domains in near future.

Let's take a comparative look of patent filing activity with some of the heavily funded tech companies of Israel. A research by Israel's IVC Research Center, a data company that tracks the Israeli tech scene, has pinpointed 24 Israeli firms which raised heavy funds in last few years and some are expected to hold an initial public offering of shares on the stock market (Link: https://www.timesofisrael.com/twenty-four-israeli-tech-firms-ripe-for-ipo-report-says/). Out of these companies, Valens Semiconductor (78), OrCam Technologies (69), Infinidat (50), Kaminario Technologies (31) and Zerto (30) have significant filings, however, none of these companies are amongst the top patent filers in US from the compiled data of last decade.

IV. Filing Trends Of Israeli Universities and Research Institutes

The list below includes the top Israeli Universities and Research Institutes actively filing patent applications in United States.

Table II: Top Israeli Universities and Research Institutes Filing Patent Applications In United States

S. No.	Israeli Universities and Research Institutes
1	Technion – Israel Institute of Technology
2	Tel Aviv University
3	Weizmann Institute of Science
4	Hebrew University
5	Ben Gurion University
6	Hadasit Medical Research Services & Development
7	Tel Hashomer Medical Research, Infrastructure and Services
8	Bar Ilan University
9	Ariel University
10	University of Haifa

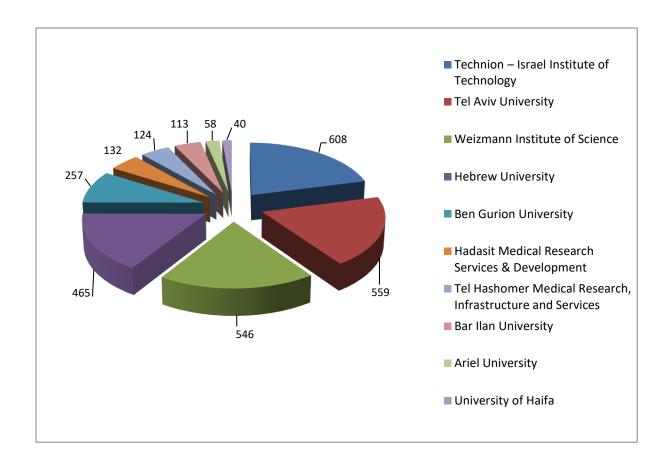


Fig. 6. Filing Activity of Israeli Universities and Research Institutes

As evident from the graph, the US patent filing activity of universities and research institutes of Israel is at par with global companies as evident from the patent filing numbers. These top Institutes have contributed about 11% of the total patent filing in US by Israeli companies and institutes.

The universities and research institutes of Israel are hub of technology innovation. The Reuters' annual ranking of the World's Most Innovative Universities includes three Israeli universities - Hebrew University of Jerusalem, Tel Aviv University and Technion-Israel Institute of Technology [19]. As evident from the list, these three universities are also amongst the top patent filers.

Israeli universities were among the first in the world to create Technology Transfer Offices (TTOs). Most of the above listed universities have established their Technology Transfer & IP companies to enable commercialization of the technologies developed within the campus. Few examples include "Yissum Research Development Company" of the Hebrew University, "Yeda Research and Development Company" of Weizmann Institute of Science, "Ramot - University Authority for Applied Research and Industrial" of Tel Aviv University and "BGN Technologies" of Ben Gurion University. These TTOs not only enable commercialization in form of product development and licensing of IP Rights but also catalyse start-up companies for fuelling further innovations.

The commercialization of products and licensing of IP rights earn huge royalties for these institutes. Each year, Israeli TTOs generate more than \$2 billion as direct sales or royalties for their Intellectual Property and lead to the formation of about 15 companies. This, in turn, helps to pump more capital from industrial partners into the basic research at these universities [20]. A publication by Globes, Israel Business News revealed that Weizmann Institute earned \$2.32 billion in royalties from licensing of its technology in last six years [21]. According to an estimate in year 2013, products developed by the Weizmann Institute have \$20 billion in annual sales [22].

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It is well known that Israel has more companies listed on the NASDAQ stock exchange than any country besides United States and China. Very interestingly, the contribution of Technion Institute in technological and economic growth of the country can be understood from the fact that two-thirds of these Israeli companies listed on the NASDAQ stock exchange were either founded by or led by Technion graduates. Further, Technion's more than 100,000 graduates till date comprise most Israeli-educated scientists and engineers, constituting over 70% of the country's founders and managers of high-tech industries [23].

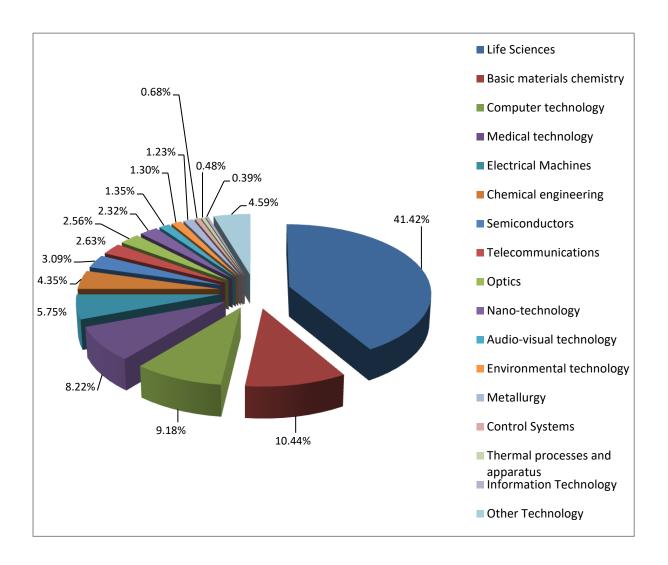


Fig. 7. Research Domain of Universities and Research Institutes

The domain of Life Sciences has been the favourite area of research for Universities and Institutes sharing 41.42% of their total patent application filing in comparison to a share of 11.65% of Life Sciences domain in overall filing trend. A probable reason for this big difference in patent filing in Life Sciences domain could be the cost involved for researching in this area. Research in Life Sciences and Medical technology requires big investment and highly sophisticated infrastructure which can majorly be afforded by large scale companies and Institutes. Consequently, patents in these fields are majorly filed by large companies and Institutes since they have sufficient funds. From the compiled data of last decade, an analysis on the patent filing by Israeli individual inventors in US revealed only about 3.5% of their total filing is in Life Sciences domain. This strengthens the fact that the funds and infrastructure plays a major role to research in this area. The earlier analysis from top patent filing companies also indicate that although research in Life Sciences and Medical is concentrated to few companies and Institutes, however, their scale of research is extremely large.

Another foreseeable reason for major research in Life Sciences in these institutes is the special provision of research funds in these areas. For example, Israel Innovation Authority provides NOFAR Incentive Program which help research in Biotechnology and Nanotechnology fields [24].

Tel Aviv University runs Israel's largest bio-medical research and teaching framework with 1,400 scientist-clinicians at 17 affiliated hospitals serving over two million people. Their scientists team up with pharmaceutical companies like Johnson & Johnson to develop new drugs and medical technologies [25].

These institutes have introduced many pharmaceutical products in the market having huge demand. For example, Exelon and Doxil developed by Hebrew University [26]. In fact, Hebrew University conduct 43% of Israel's biotechnology research [27].

V. Summary

The study has revealed some key points of patent filing activity of Israeli companies and institutes in United States. The Israeli innovation is on a growth trend with a continuous increase in numbers filed. The country is truly known as "technology hub" with global companies innovating through Israeli innovative minds. The start-up companies and individual inventors are also on innovation spirit and actively filing patents in US.

Computer Technology, Telecommunications, Life Sciences and Medical fields are the most preferred areas of research for Israeli companies and institutes. In fact, a significant portion of research by universities and institutes is towards Life Sciences and Medical technology. The universities are tapping their campus research through their Technology Transfer Offices (TTOs) which enables the commercialization through product development and licensing of IP Rights.

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I am grateful to Larry M. Goldstein who helped me to organize this study. His valuable suggestions enabled me to include data insights and improve the study. Larry is a patent attorney, specializing in computers & communications, who lives and works in the Tel Aviv area. He is a leading expert on the specific topic of "quality in patents and patent portfolios." He is the author of four books about patent quality, which are currently being translated into Mandarin by the Chinese patent office. His first book, entitled Technology Patent Licensing, is a ground-breaking review of patent pools for FRAND licensing, and was translated into Mandarin by a leading Chinese IP firm in early 2018. Larry may be contacted at larry.m.goldstein@gmail.com.

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Data Source: Questel Orbit

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