

START-UP NATION CENTRAL: FINDER INSIGHTS SERIES

ISRAEL'S INDUSTRY 4.0 SECTOR IN 2018



**START-UP
NATION
CENTRAL**

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EXECUTIVE SUMMARY

In an increasingly competitive global market, improving manufacturing processes can make the difference between a failing company and a market leader. This is why Industry 4.0 solutions – the use of technologies to improve production processes and the introduction of innovative production tools – are gaining momentum across many verticals and applications. This trend is enhanced both by the gradual shift from “far and cheap” to “local and smart” and by the fact that these technologies are becoming better and less expensive.

The global market for Industry 4.0 solutions grew to almost \$90B in annual revenues in 2018 with an expected 20% annual growth over the next five years. But there are still legacy and cultural challenges slowing the adoption of these technologies by manufacturing companies. These challenges include adapting existing human capital and machinery, the cost involved in customizing the technological solutions, and overcoming the fear of security vulnerabilities once the manufacturing facility is digitally connected.

Israel, as an innovative ecosystem well connected to global tech challenges and needs, has become a strong player in Industry 4.0, with increased attention from global players. With 230 Industry 4.0-related companies – a 60% increase from 2014 – Israel is ranked third globally in venture investments. Total funding jumped from \$253M in 2017 to \$365M in 2018, a 44% increase. However, there is still a large potential for growth, as 86% of investors invest opportunistically, with only one Industry 4.0-related investment each since 2014.

Israeli start-ups also benefit from the growing presence of around 50 large global companies related to Industry 4.0. Some of these companies run in-house R&D centers or corporate

venture arms, while others operate open innovation platforms such as hubs, accelerators, and government-supported innovation labs.

The innovation labs are just one example of the government's strategic choice to boost smart manufacturing for the purpose of improving the productivity of Israeli manufacturing industry while strengthening the leading Industry 4.0 tech sector.

As Industry 4.0 represents a broad spectrum of offerings, we have divided it into challenges and technologies. The challenges include Operations Optimization, Maintenance, Supply Chain, and Inspection and Testing; the technologies comprise IoT Platforms and Connectivity, Sensing and Imaging, Robotics, and Additive Manufacturing. Israel also excels in an additional subsector, Industrial Cybersecurity, which is both a challenge and a specific group of technologies. Operations Optimization is another subsector that stands out in the Israeli ecosystem. These two subsectors have attracted the largest number of investment rounds.

Start-Up Nation Central believes that Industry 4.0 has all the necessary components to continue its rapid growth. Nevertheless, there remain a few challenges that still need to be addressed, such as building bridges between Israeli innovation and multinationals, increasing international awareness of the Israeli ecosystem, and strengthening the Industry 4.0 community. Start-Up Nation Central is helping to address these challenges by providing various resources including the Start-Up Nation Finder database, the 2018 Israeli Industry 4.0 International Conference, and a dedicated innovation community.

WHAT IS INDUSTRY 4.0?

Industry 4.0, the Fourth Industrial Revolution, the Industrial Internet of Things (IIOT), connected industry, and advanced manufacturing are some of the terms used to define a set of technologies that digitize the entire production process by connecting physical industrial assets to systems of data collection and analysis.

For this report, Start-Up Nation Central uses the term Industry 4.0, which contains two pillars:

1. The use of technologies for data collection and analysis to improve production processes.
2. The introduction and connection of innovative production tools, such as advanced industrial robotics and additive manufacturing (industrial 3D printing), to existing production processes.



THE GLOBAL SCOPE

In an increasingly competitive global market, improving manufacturing processes can make the difference between a failing company and a market leader. Over the past few decades, developed markets have moved labor-intensive manufacturing to countries with lower labor costs, primarily in East Asia and Eastern Europe. However, smart manufacturing concepts based on the availability of new technologies related to Industry 4.0 offer much less labor-intensive manufacturing models, allowing developed countries to bring back and retain some of their manufacturing industries while providing high-wage employment at the same time.

Two forces amplify this process. First, the offshoring model is becoming less attractive due to rising wages in the offshore destinations as well as rising protectionism and the threat of trade wars. This has led to a gradual shift from a “far and cheap” to a “local and smart” mentality.

Second, Industry 4.0 technologies are becoming better and less expensive. Many technologies such as Big Data, Artificial

Industry 4.0 is not confined to manufacturing facilities and has applications across many verticals. For example, in the electric utilities sector, Industry 4.0 technologies can help manage a complex combination of conventional and renewable energy in the grid; in the construction industry, Augmented Reality can help with logistics and resource management through more accurate measurement and design visualization; and on oil and gas rigs, these technologies can remotely manage maintenance and logistics.

Intelligence, Computer Vision, AR/VR, Cybersecurity and Blockchain were not available even a decade ago. At the same time, the more traditional technologies of gathering, verifying, analyzing, and storing data have become much more advanced and dramatically cheaper in recent years. For example, the average price of IoT sensors dropped from \$1.30 per unit in 2004 to less than \$0.50 in 2018; similarly, storage costs have fallen from \$600 per gigabyte in 1992 to less than 1 cent today and bandwidth costs have dropped from \$1,250 per Gbps at the start of the century to less than \$10 today.

These two forces have led the global market for Industry 4.0 solutions to grow to almost \$90B in annual revenues in 2018, up from \$76B in 2017, with an expected 20% annual growth in the next five years.¹ Accordingly, investors have been increasingly active in the sector, with total investment jumping by 54% – from \$5.2B in 2017 to \$8B in 2018.² And as global competition over manufacturing leadership heats up, Europe and Asia are gaining strong momentum in developing Industry 4.0 technologies, catching up quickly with North America.

¹ HSRC, Industry 4.0 Market & Technologies, 2018

² Pitchbook

CHALLENGES FACING INDUSTRY 4.0

While the arguments for adopting Industry 4.0 solutions are strong, there are still considerable issues to address in order for manufacturing companies to adopt these technologies. We have divided these issues between legacy and cultural challenges on the one hand and technology-related challenges on the other.

LEGACY AND CULTURAL CHALLENGES:

This group of challenges relates to any decision about whether to invest in new and expensive technologies. While these investments are often profitable in the long run, they demand a corporate culture that is open to change. This is not the case in many companies in the manufacturing sector, especially in medium-sized companies.



COMPATIBLE MACHINERY

Existing manufacturing equipment was designed to focus on efficiency, safety, reliability, and resilience. However, connectivity – the backbone of Industry 4.0 technologies – was rarely a requirement. Therefore, for manufacturers to enjoy the potential of these new solutions, they need to invest in making their current equipment connected.



HUMAN CAPITAL

The change to a connected environment requires a different skill set, one that existing manufacturing workers usually lack. As a result, many employees need to be trained to work with systems that are very different from the ones they have been using for many years. This process is complicated, expensive, and time-consuming.



FEAR OF DISRUPTION

Industrial processes in competitive industries have become extremely optimized over the years in order to reach maximal efficiency. Companies fear that tinkering with the systems that control current processes in order to make them compatible with Industry 4.0 technologies to increase efficiency over time may reduce their efficiency and compromise their competitive position in the short term.

TECHNOLOGICAL CHALLENGES:

Even dynamic companies that choose to adopt Industry 4.0 solutions face not insignificant technological challenges that can require heavy capital investment.



THE SHIFT FROM CLOUD TO EDGE COMPUTING

The rise of cloud computing has been critical to the development of Industry 4.0 by enabling the storage of huge amounts of data at lower cost. However, this has become a problem as the amount of data has increased exponentially. Transferring all of this data to the cloud and back can be a slow and costly process as well as creating additional security risks. As a result, the focus has shifted to edge computing, which allows data to be stored and analyzed on-site. This shift requires substantial capital investment as well as security and processing solutions.



SECURITY VULNERABILITIES

Some Industry 4.0 applications require communicating commercially sensitive data to third parties, including small companies whose cybersecurity protection may not be strong enough. It is a challenge to keep the IP safe during the process and it is important to make sure that communications are secure before implementing such a system. One recent example that illustrates these risks is the Norsk Hydro ransomware incident, which cost the company \$40M a week and forced the Norwegian-based aluminum producer to shift to manual operations.³



CUSTOMIZATION

The implementation process can be long and complicated, as most solutions need to be customized for each client. The market for Industry 4.0 solutions is highly fragmented, with 68% of manufacturers comprising small to medium-sized players,⁴ each one with its own systems and standards. This requires Industry 4.0 service providers to work closely with clients to adapt to their individual needs.

³ <https://www.zdnet.com/article/aluminium-producer-switches-to-manual-operations-after-extensive-cyber-attack/>
Frost & Sullivan, Global Industrial Automation Market Outlook, page 20

ISRAELI INDUSTRY 4.0

ISRAELI INDUSTRY 4.0 ECOSYSTEM: END OF 2018 SNAPSHOT



230

Companies



90

Investors in 2018
including VCs, CVCs,
and Angel investors
(Israeli and foreign)



Multinationals:

23

R&D
Centers

11

Hubs



8

Accelerators
and
Incubators



Government:

Over \$100M

in government
support programs



Israel has become a strong player in Industry 4.0 over the past few years. The growing number of start-ups has been supported by other ecosystem elements, including the rising presence of multinationals, government incentives, and increased capital availability. All of this has led to growing global attention from both investors and strategic players.

Despite its leadership in ICT sectors, Israel's strength in Industry 4.0 may be surprising. After all, Israel does not have a notably

strong manufacturing sector that can serve as a first customer or from which start-ups and entrepreneurs can spin out. As a result, many start-ups in this sector (as well as in Fintech and Digital Health) are not founded by people with field expertise in manufacturing. Rather, these are deep technology experts looking for applications for their strong capabilities in big data, AI, communications, sensors, and algorithms. They believe that this sector has great potential as a place to apply their skills and create value for many industrial firms.



SEEBO: STRATEGIC DECISION TO MOVE TO INDUSTRY 4.0

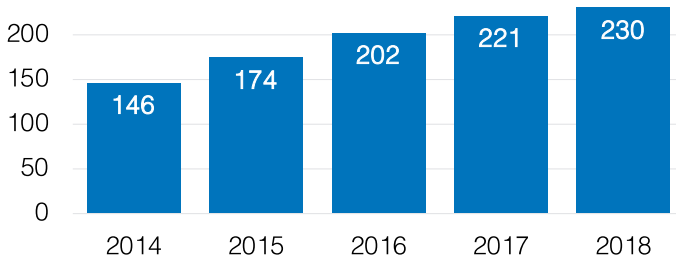
Many Israeli entrepreneurs involved in Industry 4.0 were initially involved in other sectors before discovering that their technology could be applied to the industrial market. One such example is Seebo. Founded by two brothers, Lior and Liran Akavia, Seebo specialized in using advanced sensors in video game controllers to track player movements with high accuracy and translate them into game actions. The team discovered that similar sensors are used in modern manufacturing plants to generate large

amounts of data, but that this data was not being analyzed to its full potential, presenting a significant opportunity on a much larger scale. They created an industrial AI software solution for factories to analyze production-line data and suggest process optimizations that increase production throughput while ensuring quality. The company has since raised \$25M and is working with many international companies, including P&G, ChemChina, and Nestlé.

COMPANIES

The number of Industry 4.0 companies in Israel has increased steadily by almost 60% since 2014 (see Figure 1).⁵

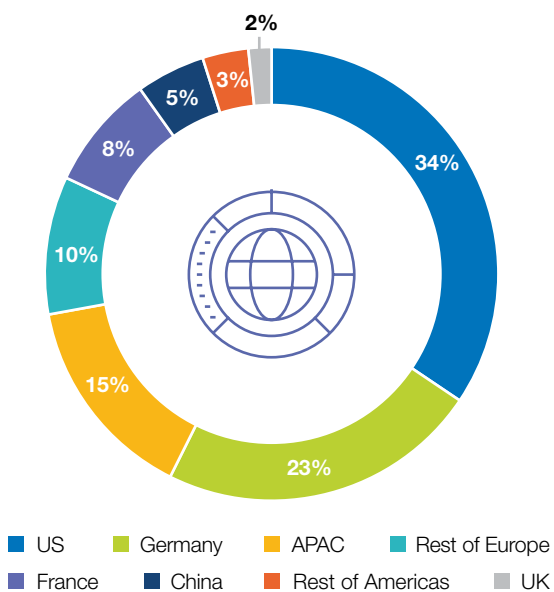
Figure 1: Number of Active Israeli Companies



In addition to the Israeli companies, around 50 large multinational corporates operate in Israel in the Industry 4.0 space. These companies are engaged with Israel in a variety of ways, including through R&D centers, hubs, investment arms, investments in other funds, and innovation centers. More specifically, most of these multinationals are involved in some form of “open innovation,” while others engage only in “closed” R&D activities. This is consistent with the greater emphasis on open innovation that we have seen across the ecosystem in the past few years. In fact, Industry 4.0 has a greater proportion of open innovation than other sectors, with 61% of all activities in open innovation as opposed to 54% for the ecosystem as a whole.

In terms of geographical distribution, European multinationals (including Germany, France, the UK, and the rest of Europe) form the largest group at 43% followed by the US and Asia (see Figure 2). This represents a higher percentage for both Europe and Asia than the overall ecosystem, where the US dominates. This is perhaps due to the greater importance of manufacturing in the economies of both Europe and Asia relative to other sectors in Israeli high tech.

Figure 2: Breakdown of Industry 4.0 Activities of Multinational by Geography



⁵ The number of active companies in 2018 is likely to rise, as some new companies may have not yet entered our database

The following are some examples of initiatives that multinationals have recently launched in Israel:



ST-UP – An accelerator opened in 2018 by ST Microelectronics, a Swiss-based semiconductor manufacturer, that targets mature start-ups and helps them scale by providing access to the company's business units and partners around the globe.



Konnect – The Israeli innovation arm of Volkswagen opened operations at the beginning of 2018 with the purpose of connecting the group to the Israeli ecosystem. They recently started a project for smart manufacturing within the group and are now looking for Israeli Industry 4.0 solutions.



PMatX – This open innovation platform – one of the Innovation Labs programs of the Israel Innovation Authority (see below) – is a collaboration between the German healthcare company Merck and the American semiconductor company Flex. Opened in February 2019, PMatX aims to advance the integration of innovative materials and novel manufacturing methods in manufacturing processes.



Enel – The largest European energy company and a global leader in renewable energy, Enel engages with the Israeli Industry 4.0 ecosystem via several channels. The Enel Innovation Hub opened in August 2016; Infralab, a collaboration between Enel and Israeli construction company Shikun & Binui, was started as part of the Israel Innovation Authority's Innovation Lab program; and Enel X, dealing with non-energy innovation, launched its activities in Israel in March 2019.



Bright Machines – This US company (a spin-off from Flex) opened its largest R&D center worldwide in Israel in July 2018 and is now in the process of expanding. The company develops software for robotics using artificial intelligence with the aim of creating “smart robots” that can be trained quickly to perform multiple tasks.



SIEMENS DYNAMO: HOW TO BETA TEST START-UPS TOGETHER WITH LOCAL MANUFACTURING PARTNERS

BY RAN LIVNAT, PARTNER,
SIEMENS DYNAMO

Siemens launched its open innovation program, Siemens Dynamo, in Israel in 2017. The program aims to discover Israeli start-ups that can be integrated into the digital factory of the future and be offered by Siemens to its industrial clients.

The Siemens Dynamo model is unusual because it works with established manufacturers as well as with start-ups. In addition to allowing the selected start-ups to validate their solutions in Siemens manufacturing facilities, Siemens Dynamo offers another model of three-way collaboration between Siemens, its manufacturing customers, and Israeli start-ups.

For instance, in one of its projects Siemens Digital Industries collaborated with Keter Plastic, an Israeli manufacturer, and the Israeli start-up Kitov Systems. The result was the detection of defects in both the product and the production process using Kitov's AI-based visual quality control. This success led to the purchase of a Kitov solution by Keter and to the onboarding of Kitov to the Siemens Dynamo program.

Tali Segall, VP Innovation at Siemens Industry Software, points out: “When we launched the Siemens Dynamo program, it was clear to us that we would like to include local manufacturers in the program. We approached several of our customers in Israel who are known for their excellence and innovation in global markets, including the Mexichem Group (owner of Netafim) and the Keter Group, and with each of them we have managed to cooperate at least once in the past year in examining new technological solutions.”

GOVERNMENT INITIATIVES

The Israeli government has recognized the potential value of Industry 4.0 solutions in improving the productivity of the Israeli manufacturing industry, as well as in establishing Israel as a leading ecosystem in advanced manufacturing technologies. In 2018, the Ministry of Economy published a strategic plan for this area emphasizing the need for connecting the manufacturing industry with tech start-ups developing Industry 4.0 solutions.

The Israel Innovation Authority, which is responsible for promoting cutting-edge innovation, has also emphasized

advanced manufacturing as a strategic theme in its five-year strategic plan. Accordingly, alongside the standard MOFET program that supports R&D for advanced manufacturing, the Innovation Authority also launched the Innovation Labs Program in 2017. This program encourages open innovation and offers entrepreneurs the opportunity to reach proof of concept through access to a large corporation's unique technological infrastructure and industry expertise. Under this program there are currently three (out of five) innovation labs in the field of advanced manufacturing:



PMatX in Yavne,
operated by Merck and Flex



Let-Lab in Nazareth,
operated by Ham-Let



Infralab in Haifa,
operated by Enel and Shikun & Binui

The Ministry of Economy is setting up two institutions that will assist Israeli Industry 4.0 by providing subsidized consulting and assistance as well as serving as a knowledge source and training for managers: The Institute for Advanced Production

that will focus on robotics, digitization and IOT and The Center for Resource Efficiency for optimizing production of energy, raw materials, water, etc. The institutes are expected to start operating in November 2019 with a budget of \$15M each.

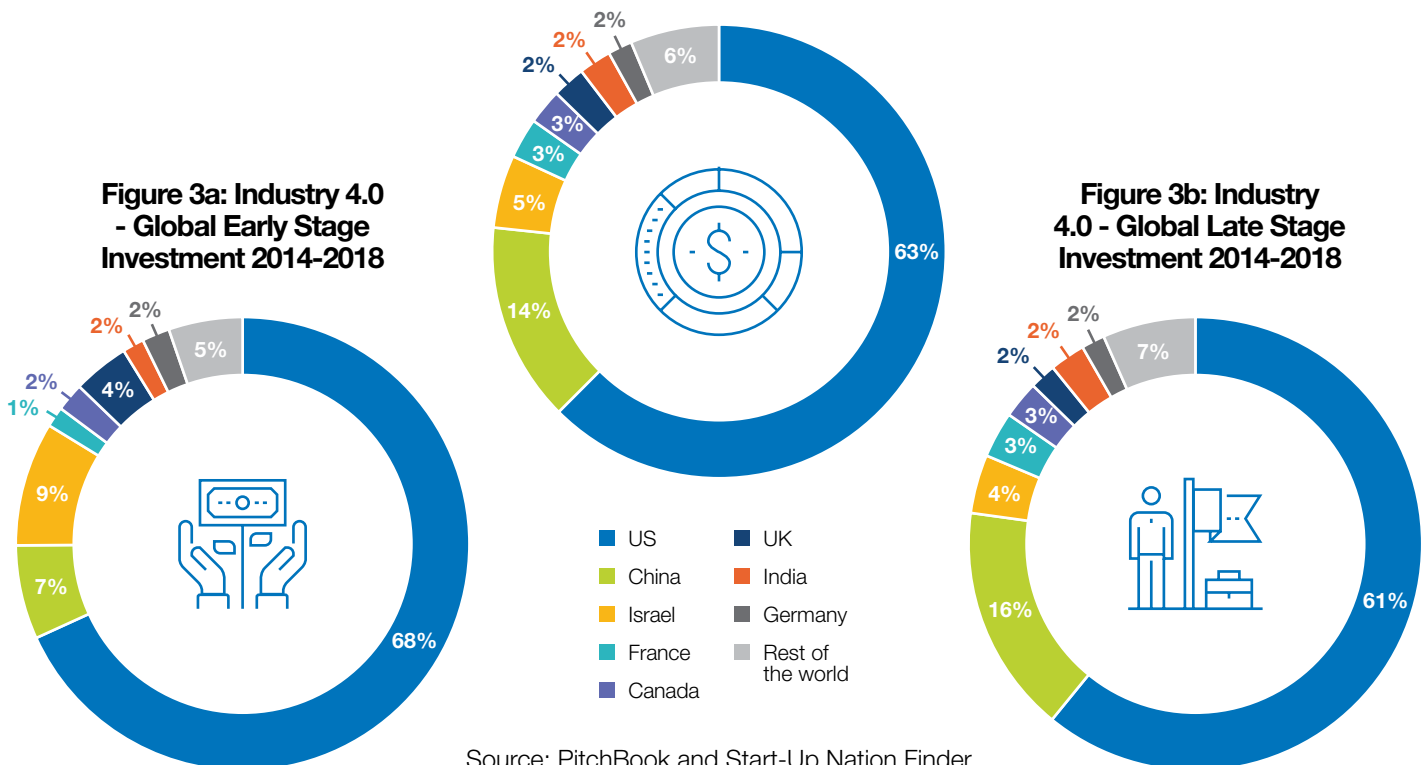
FINANCING

CAPITAL AVAILABILITY

Israel has established itself as an important location for global investors looking for innovative Industry 4.0 companies. Over the past five years, Israel ranked third in venture investments in Industry 4.0 companies after the US and China (see Figure 3). This is not entirely surprising, as in Israel innovation primarily takes place within start-ups that raise venture investments,

whereas in other industrialized countries it takes place mainly within large corporations that are financed in other ways. If this data is split between early and late stage investment, we can see that Israel is stronger in obtaining early stage funding, for which it is in second place among countries worldwide, while for late stage funding it is in third place (see Figures 3a and 3b).

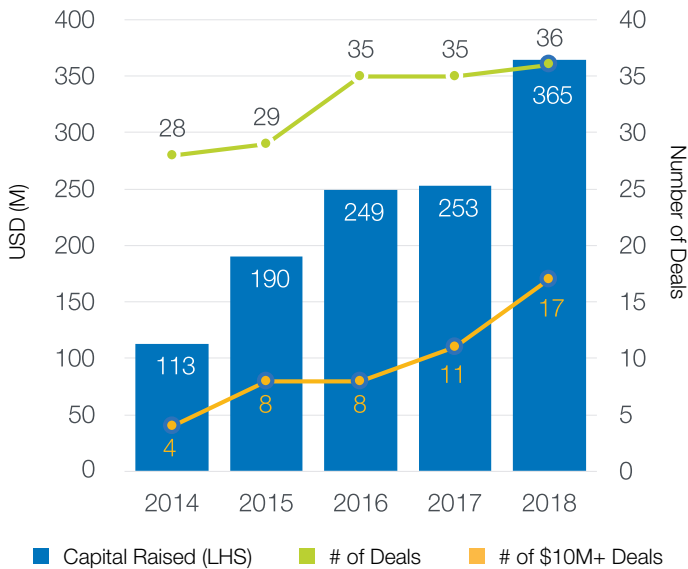
Figure 3: Industry 4.0 - Global Equity Investment 2014-2018



Source: PitchBook and Start-Up Nation Finder

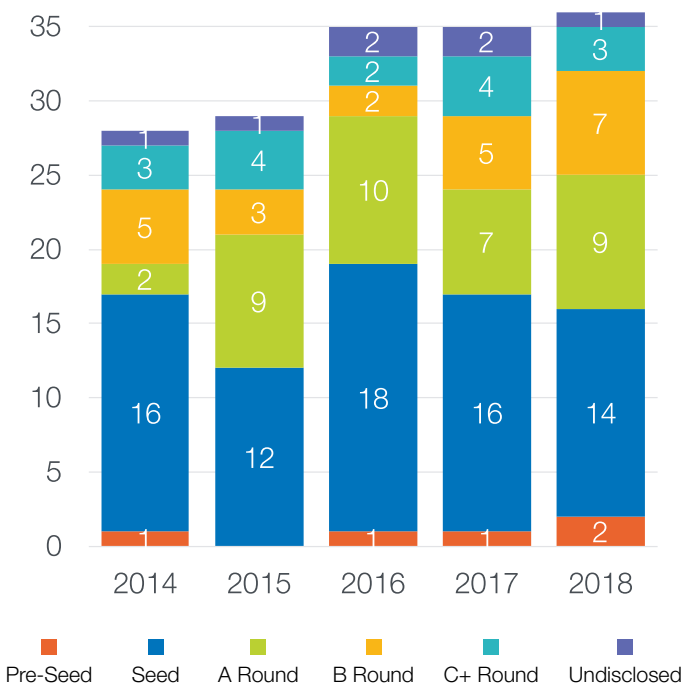
The amount of capital raised by the sector has increased consistently since 2014 along with the number of deals. Furthermore, 2018 may prove to be a milestone for this sector, as total funding jumped from \$253M in 2017 to \$365M in 2018, a 44% increase (see Figure 4), without a comparable increase in the number of deals, indicating that the sector is maturing. This is evident in the increase in the number of rounds over \$10M.

Figure 4: Israel Industry 4.0 Equity Investment



While the number of large rounds has increased, the mix between different types of rounds has not changed substantially since 2017. Seed and A rounds continue to dominate, indicating that the deal flow is still strong.

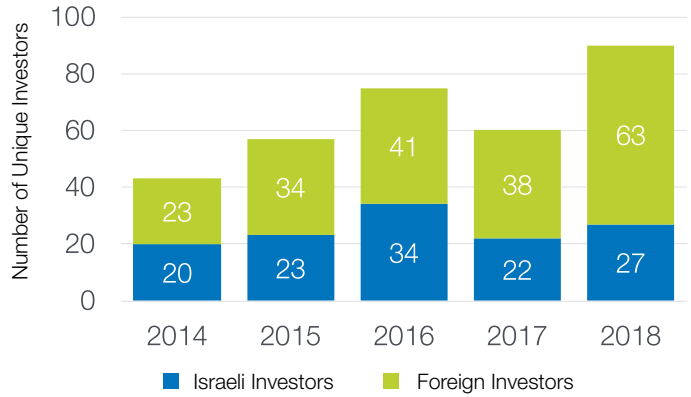
Figure 5: Number of Investment Rounds by Stage



INVESTORS

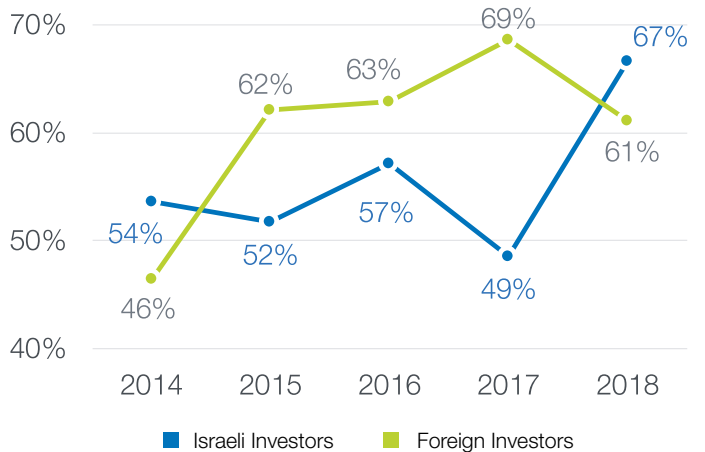
The number of investors participating in Industry 4.0 deals has more than doubled since 2014 (see Figure 6). The increase is mostly due to the dramatic rise in the number of foreign investors in this sector, far outnumbering Israeli investors.

Figure 6: Israeli vs Foreign Investors



However, when we focus on investment rounds in 2018, 67% have at least one Israeli investor compared to 61% with at least one foreign investor. This stems from the tendency of foreign investors to invest together; in rounds with foreign participation there were 2.9 foreign investors on average compared to 1.1 Israeli investors in rounds with at least one such investor.

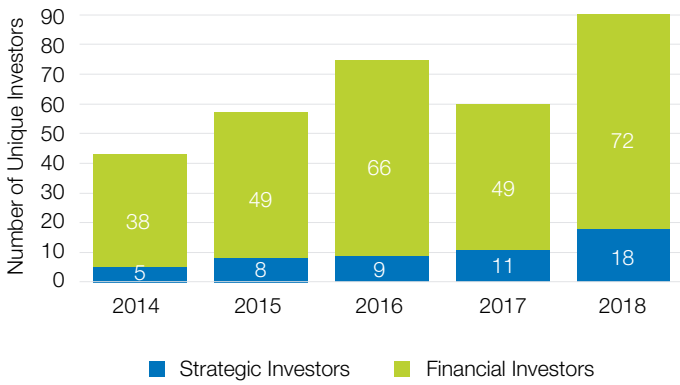
Figure 7: Investor Participation - Israeli vs Foreign



Another important distinction in this sector is between purely financial investors (angels, crowdfunding, VCs, private equity) and more strategic investors (corporates and CVCs). While financial investors continue to be far more active, there has been a notable increase in participation by strategic investors. This is a welcome development, as strategic investors such as Intel Capital and GE Ventures (the two largest Industry 4.0 investors globally)⁶ provide credibility, access, expertise, and the ability to attract additional clients. These features are essential to start-ups and can help them tailor their products to actual market needs.

⁶ Source: Pitchbook

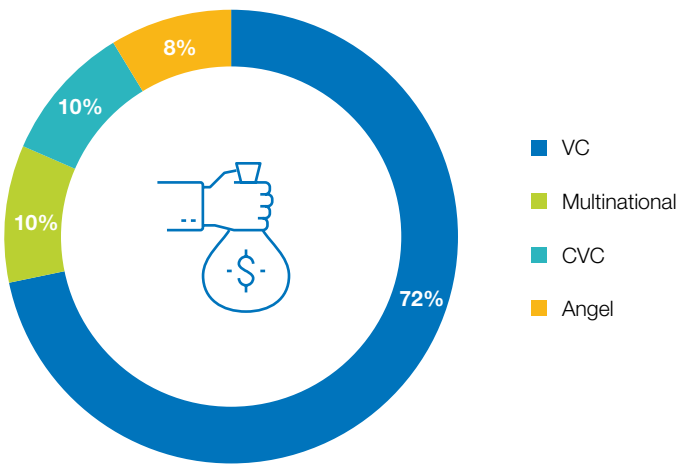
Figure 8: Strategic vs Financial Investors



The preponderance of financial investors in Industry 4.0 is yet another feature of its overall innovation ecosystem, which focuses on entrepreneurship and VCs. While 80% of investors in Israel were financial in 2018, globally the figure was under 60% (see Figures 9 and 10).

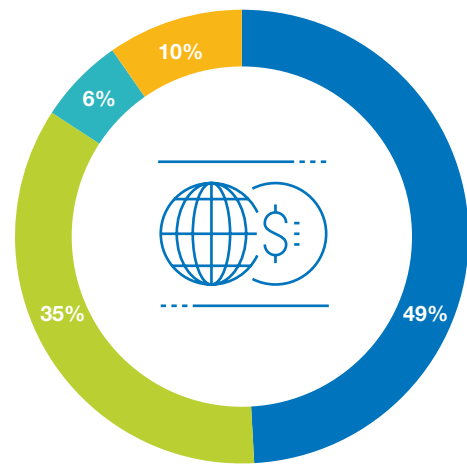
Another characteristic of strategic investors in Industry 4.0 is that they tend to invest later in a company's life cycle than financial investors. The median time for strategic investors to invest was 3.25 years after the company was established, whereas financial investors took 2.25 years. This reflects the tendency of strategic investors to favor more established companies even though many do invest in early stage, especially when they have a local presence.

Figure 9: Investor Type, 2018 - Israel



Source: Start-Up Nation Finder

Figure 10: Investors Type, 2018 - Global



Source: PitchBook



As the Industry 4.0 sector is still young, most investors (86%) in Israeli Industry 4.0 have only invested in one company in the sector. This suggests that the majority of investors are not focused on the sector specifically but instead invest opportunistically. The minority of investors that have invested in more than one company in the sector participated in 34 rounds in 2018, up from 12 rounds in 2014.

This increase is mostly due to more follow-on rounds in the same company. At the same time, the number of rounds that these investors have committed to new companies has held steady at an average of 20 per year over the last four years. As this sector matures, we will probably see more dedicated investors focusing on Industry 4.0 companies.

The leading investors from 2014-2018 by number of companies were mostly Israeli VC investors:

				
OurCrowd (Israeli), Crowdfunding and VC, 13 companies	Aleph (Israeli), VC, 4 companies	83North (Israeli), VC, 4 companies	Grove Ventures (Israeli), VC, 4 companies	Autodesk Investments (foreign), CVC, 4 companies

INTERVIEW WITH BOAZ PEER
INVESTMENT DIRECTOR (ISRAEL & EUROPE),
QUALCOMM VENTURES



Qualcomm Ventures has been one of the leading strategic investors active in Israeli Industry 4.0.

Question: Why is Industry 4.0 of interest for Qualcomm?

Answer: IoT is one of the fields of growth for Qualcomm today. We are looking at different domains such as automotive, AI, robotics, Cybersecurity and also Industrial IOT which is expected to grow significantly in the next few years with the adoption of technologies such as 5G, edge computing and AI.

Question: Which areas of Industry 4.0 do you invest in?

Answer: We have a particular interest in the areas of connectivity, cybersecurity, AI and analytics. For example, we invested in Coretigo which is involved in wireless communication for the factory automation market, and CyberX which provides IIOT cybersecurity platform. We have also invested in several non-Israeli Industry 4.0 companies including Realwear which is a leader in AR training platforms for connected workers.

Question: Why is Israel an interesting place to look for Industry 4.0 start-ups?

Answer: Many Israeli startups have multidisciplinary capabilities, an understanding of both cloud and edge systems and expertise that comes from fields such as computer vision, security and connectivity that are required for Industry 4.0 growth.

Question: When is the right time to invest in the sector?

Answer: Historically, investing in innovative companies in a new market offers fair valuations that can later provide high returns. Successful investment can also take place during the “hype cycle” of a technology/domain but the valuations will be richer, and the ROI might be affected. Industrial IOT has a long sales cycle and slower adoption of new technologies, which makes it a more complex sector to invest in. However, some of the companies that are active in this domain have started to get market traction and have the potential to become a success story, which will help drive the market forward.

EXITS

Although the sector is relatively young, it has already generated more than 15 exits since 2014.

In 2018 there were two acquisitions, with the first occurring in December when Orbotech acquired Frontline PCB Solutions for \$115M.⁷ Frontline PCB was founded as a joint venture in 1998 by Orbotech and Valor Computerized Systems Ltd, two related Israeli companies founded in the 1980s and involved in creating solutions for the manufacturing of electronic components.

Frontline PCB develops computer-aided manufacturing (CAM) and engineering software solutions for printed circuit boards (PCBs).

The second acquisition of 2018 was of Precognize, an industrial IoT software company that predicts shutdowns, leakages, and inefficient operation of complex industrial systems via deep analysis of existing data. Precognize was sold to the German manufacturer Samson AG for \$25M.

⁷ Orbotech itself, which has been public for many years, was acquired by the US-based equipment producer KLA-Tencor for \$3.3B in February 2019

SUBSECTORS

Industry 4.0 comprises a wide range of technologies and solutions. Therefore, when we analyze this sector it is helpful to look at the performance of its different subsectors. We have divided the sector into nine subsectors, four with a focus on manufacturing challenges (Operations Optimization, Maintenance, Supply Chain, and Inspection and Testing); four with a focus on technologies (IoT Platforms and Connectivity, Sensing and Imaging, Robotics, and Additive Manufacturing); and one, Industrial Cybersecurity, that is both a challenge and a specific group of technologies.⁸

SUBSECTOR DEFINITIONS AND NOTABLE ACTIVITIES

Industrial Cybersecurity

The protection of data and connected systems

This is the second-largest subsector and consists of 32 companies. It has raised the most money – almost half of all 2018 sector funding – and of all the subsectors, this one is the most familiar to investors, as many are investors in cybersecurity outside of Industry 4.0. This subsector is frequently an entry point into Industry 4.0 for manufacturers as they try to protect their systems from hackers. In 2018 we saw six large B rounds: Claroty raised \$60M, Armis and ThetaRay raised \$30M each, and Radiflow, CyberX, and Indegy raised \$18M each.

CHALLENGES

Operations Optimization

Solutions that increase yield, decrease the consumption of raw materials or energy, and enable a faster time to market

This sector consists of 58 companies, making it the largest single subsector. It tends to attract mostly smaller, early stage investment rounds, with eight rounds in 2018, of which the largest was Grid4C with \$5M.

Maintenance

Maintenance and predictive maintenance of production machinery to reduce downtime

There are 16 companies in this subsector, but it has not attracted a large share of funding in most years and 2018 saw just one funding round. However, 2019 has already been a better year with two rounds so far, including a \$25M C round raised by Augury, which predicts faults in machinery before they occur using the internet of things and artificial intelligence.

Supply Chain

Improvement of supply chain efficiency and visibility

There are 22 companies in this subsector. We are seeing more and more multinationals taking a holistic approach, seeking to optimize not just their manufacturing facilities but the entire chain of production, including materials from vendors and distribution to customers. Funding picked up considerably in 2018, with an 83% increase due to three large rounds: \$20M for Commonsense Robotics, \$16.5M round for Windward, and \$9.5M for Contguard.

Inspection and Testing

Plant inspection and testing of materials and products

This subsector contains 19 companies. While it did not attract much capital from 2014-2017, this changed in 2018 when two companies, Inspekto and Kitov, raised \$10M series A rounds. The largest single investment to date in the subsector occurred in April 2019 when Proteantecs, a Haifa-based start-up whose product predicts faults in electronics before they become failures, received a \$35M investment led by Viola and Intel Capital.

TECHNOLOGIES

IoT Platforms and Connectivity

Communication and integration of data

This subsector consists of 31 companies. One of the main challenges for the subsector is the increased need for better connectivity to facilitate high-level data gathering and analysis. Connectivity is key to implementing the efficiency measures that Industry 4.0 offers. There were three big rounds in 2019: Hailo, a company that facilitates moves from cloud to edge computing, raised \$8.5M, while Celeno Communications and CoreTigo raised \$10M each.

Sensing and Imaging

Devices involved in data collection

This subsector consists of 20 companies but did not attract large amounts of capital in 2018. In that year there were with just two deals, both at seed stage: EZMEMS (\$1.6M) and TriEye (\$3M). However, more has been raised in 2019 with two major deals: Newsight Imaging received \$5M in an A round from Orbbec, a Chinese company, while Williot raised \$30M in a B round from eight different investors, including four foreign strategic.

Robotics

Advanced machinery for complex task automation

This subsector contains 16 companies. Like additive manufacturing it is a disruptive subsector, which means that adoption is slower and the number of funding rounds tends to be limited. Nevertheless, when investment does occur, it is usually in large amounts. The median round size from 2014-2018 was \$19M, the highest of any subsector. In 2018 only one start-up received funding: Airobotics with \$40M.

Additive Manufacturing

3D printers and the surrounding ecosystem

There are 16 companies in this subsector. While funding was strong from 2014-2016, it has been weak over the past two years. This is a somewhat unique subsector that focuses on disruptive hardware technology that replaces existing production methods rather than improving them. This requires longer testing periods and has additional barriers to adoption, which is why investors are more reluctant to invest in this area. Nevertheless, there are three larger companies in this space: Nano Dimension and Stratasys are public companies, while XJet last raised a series C round.

⁸ Naturally, many companies fall into more than one category as they try to solve a specific challenge with a specific technology. But for the sake of simplicity we have divided the subsectors in a mutually exclusive way according to the main innovation focus of the company

ISRAELI INNOVATION: INDUSTRY 4.0

THERE ARE MORE THAN **200** INNOVATIVE INDUSTRY 4.0 START-UP COMPANIES IN ISRAEL

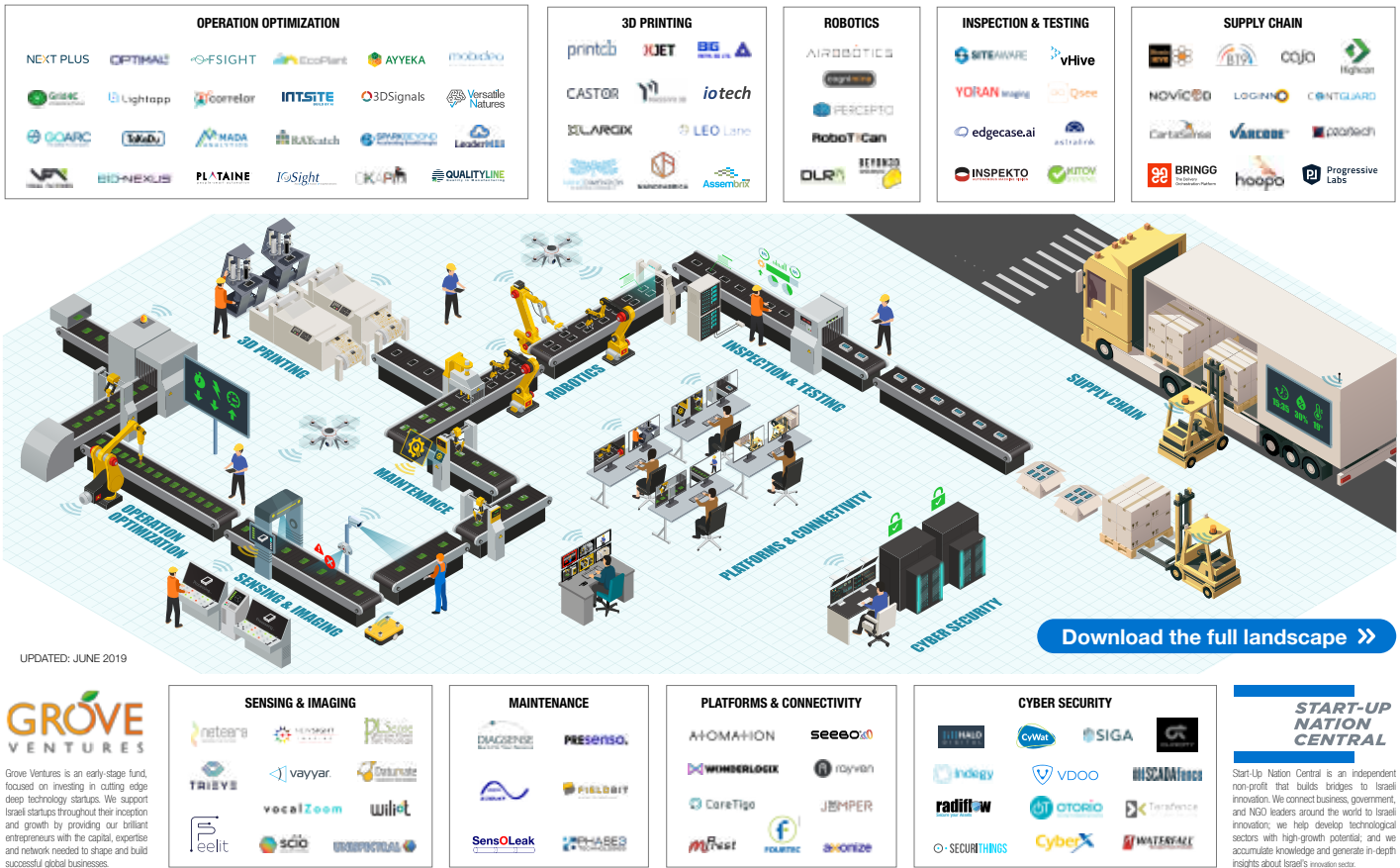
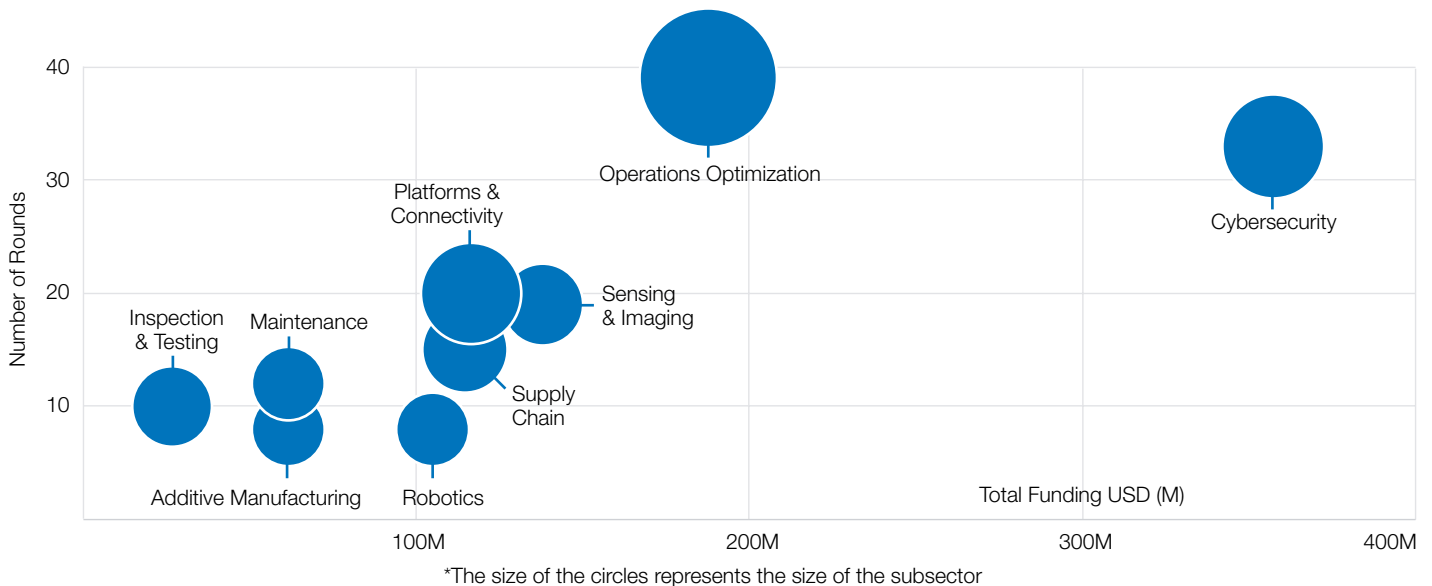


Figure 11: Subsector Performance, 2014-2018



As Figure 11 shows, two subsectors, Cybersecurity and Operations Optimization, stand out.

The Operations Optimization subsector (alongside IoT Platforms and Connectivity) represents the core of Industry 4.0, as it deals with improving efficiency in industrial sites. Accordingly, it has attracted interest from many entrepreneurs looking to solve Industry 4.0 challenges. The strength of Industrial Cybersecurity is more straightforward

and is due to Israeli expertise in cybersecurity solutions, which can be adapted to industrial environments.

While some subsectors represent more established technologies, others include fairly recent developments. For example, the median company age for both Supply Chain and Operations Optimization is about 7 years, while companies offering much newer technology, such as Additive Manufacturing, have a median age of only 3.5 years.

INDUSTRY 4.0 – A FOCUS SECTOR FOR START-UP NATION CENTRAL

As the data shows, Israeli Industry 4.0 is gaining momentum with more companies and more funding every year, offering a wide variety of solutions. Start-Up Nation Central believes that this sector has all of the necessary components to continue its rapid growth.

In order for this sector to continue its growth and reach its full potential, we believe there are a few challenges that need to be addressed, including building bridges between Israeli innovation and multinationals, increasing international awareness of the Israeli ecosystem, and strengthening the Industry 4.0 community.

BUILDING BRIDGES

At the early stages of a start-up's life, one of the greatest difficulties is finding the first customer, as large manufacturers want an indication that the product has already been implemented successfully elsewhere. This challenge can be met by working with an Israeli manufacturer, but it may not be enough to convince a large foreign corporate who will still demand a pilot in its location.

Start-Up Nation Central aims to help mitigate this challenge by building bridges between Israeli Industry 4.0 start-ups and potential customers. Start-Up Nation Central works with clients (mainly global corporations) from a variety of industries. In 2018 we hosted dozens of multinationals from diverse industries including chemicals, materials science, fashion, food and beverages, retail, and energy that expressed interest in Industry 4.0 solutions.

One of Start-Up Nation Central's core projects in this domain, led by the sector development team, is the collaboration between German Mittelstand manufacturers and Israeli start-ups. German SMEs are renowned for excellence in research, production, and export prowess, and their goods carry the brand of highest quality worldwide. We are convinced that Israeli start-ups and German SMEs can cooperate successfully.

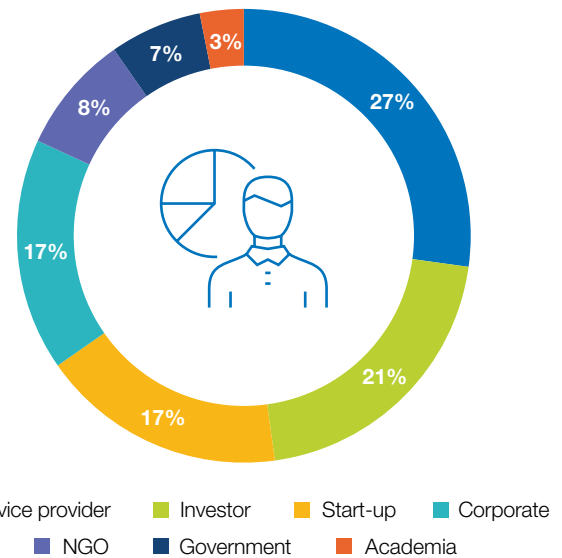
INTERNATIONAL AWARENESS

Start-Up Nation Central, along with Grove Ventures, organized one of the first international Industry 4.0 conferences in Israel. The 2018 Israeli Industry 4.0 (II4) Conference, titled "Beyond Man and Machine," attracted more than 400 participants and brought together start-ups, industry leaders, experts, and MNCs and displayed the latest insights in the Industry 4.0 space while showcasing the latest cutting-edge technologies made in Israel. In 2020 we plan to hold an II4 Week, which will be a large annual international event offering a unique gathering of Industry 4.0 experts. Events will run for a full week and will include roundtables, panels, workshops, forums, competitions, and more. For more details please visit www.israelindustry40.com

Start-Up Nation Central also creates many opportunities through Start-Up Nation Finder, our innovation discovery platform where anyone can research and contact companies, technologies, and investors in Israel.

Figure 12 shows the breakdown of users on Finder searching for companies that contain the tag "Industry 4.0." This is quite a diverse group, with service providers (mostly consulting firms) making up the largest share, followed by investors, start-ups, and corporates.

Figure 12: Share of Visitors Searching for Industry 4.0 on Finder



The following five companies were the most searched for among Israeli Industry 4.0 companies on Finder in 2018:



STRENGTHENING THE ISRAELI INDUSTRY 4.0 (II4) COMMUNITY

In 2018, Start-Up Nation Central established the Israel Industry 4.0 Community (II4), with the aim of gathering top Israeli innovators and financiers, along with industry leaders, to collaborate online and offline, share information, and enhance the industry 4.0 ecosystem. In 2019, the community has already initiated several events with global corporates looking for innovative technologies, who have leveraged the II4 platform to create new business opportunities and strategic alliances.

If you are a global corporate, start-up, or investor interested in Israel's Industry 4.0 ecosystem, join our community today: www.ii4community.org.



METHODOLOGY

DATA SET

Israeli companies

The numbers and definitions relating to Israeli innovation and entities correspond with those of Start-Up Nation Finder. As a result, the companies considered for this report are those that were founded by Israelis and which pursue R&D activities in Israel; we have excluded service providers.

Subsectors

This report organizes Israel's Industry 4.0 sector into subsectors. Subsector division organizes the relevant companies into a simple taxonomy. Some companies offer multifaceted technologies and therefore could be assigned to multiple subsectors. However, for the sake of deriving investment and tech trends, we have associated each company with only one subsector that reflects the company's major focus. Figures representing the numbers of start-ups and investments in Israeli Industry 4.0 and its subsectors are likewise exclusive (e.g. we do not associate one company with multiple subsectors).

Time frame

The data used here is generally for the period 2014-2018 unless otherwise stated. This is the period during which data was compiled systematically for Start-Up Nation Finder.

FINANCING

Financing refers to any equity transaction (e.g. VC, corporate, angel investments, and private equity in the growth stage) excluding major liquidity events, which are considered exits. In cases where companies receive investments from incubators conjointly with grants from the Israel Innovation Authority, the latter are included in the funding amount and are not specified. Fundraising amounts entail only the value invested in a given time period; even if a deal includes terms for future obligations, we do not include the pending conditions in the amounts listed in this report. Some investment figures may include funding that does not appear to the public on Start-Up Nation Finder. These amounts reflect data that Israeli companies disclosed to Start-Up Nation Central in confidence and which they prefer remain private while still being factored into aggregates.

ABOUT START-UP NATION CENTRAL

Start-Up Nation Central is an independent nonprofit that builds bridges to Israeli innovation. We connect business, government, and NGO leaders from around the world to Israeli innovation through highly customized business engagements and through Start-Up Nation Finder, an up-to-date, easy-to-use, free online platform for discovering and connecting with thousands of relevant Israeli innovators.

We identify technological sectors with high growth potential and help them develop to maturity. We are currently focused on the Digital Health, AgriFoodtech, and Industry 4.0 sectors, providing them with exposure to global audiences, helping them develop practical tools, attracting investors, and establishing and nurturing tech communities to increase collaboration, knowledge-sharing, and skill expansion.

We accumulate knowledge and generate in-depth insights about Israel's innovation sector and share these findings with our clients and partners.

**Start-Up Nation Central –
Your partner for Israeli innovation.**

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For more information on the Israeli Industry 4.0 sector and the companies cited in this report, please visit:

finder.startupnationcentral.org



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