Warm Springs Innovation Center

Phase 2: Gap Analysis

View of Warm Springs BART station and pedestrian bridge from Innovation Way, looking east.[1]

May 30, 2018

[1] https://fremont.gov/DocumentCenter/View/21074

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1.0 Executive Summary of Key Findings

This document provides an assessment of the current state of the Warm Springs ecosystem. It summarizes information collected from over 5,500 pages of secondary material, associated websites, and reports from BAE Urban Economics (BAE) and John Friedman Alice Kimm Architects (JFAK). Additionally, 95 interviews[2] were conducted in 77 sessions with individuals and groups to understand sources of innovation, sources of capital, current innovation enterprises, regional product development activities, visible and influential stakeholders, higher-education connections, and existing innovation cultivators[3] that are active or planned.

The following is a summary of the most important key findings in the report.

1. The Bay Area has an abundance of support for early stage companies. The Bay Area is home to many innovation cultivators that support software start-ups or early stage companies (considered from seed stage to Series A) targeting various industry verticals. Some are government or university backed, but many are operated by private investors.
2. Growth stage (Series B and higher) companies are not as well supported, particularly in hardware. A key challenge for growth stage companies is understanding how to scale up efficiently while staying within financing constraints. There are few active technical experts, mentors, advisors, and consultants that serve this need and the ones that do exist are not well connected.
3. Two industry sectors have the most potential for a Warm Springs Innovation Center (WSIC) focused on manufacturing - cleantech and medtech. Cleantech and medtech each have manufacturing elements. Medtech, in particular, has a well-connected community of small companies and university resources, with champions in the community who can connect start-ups to the manufacturing community and enable product realization. Cleantech is a good secondary vertical to consider, but since it comprises a variety of disparate technologies with diverse manufacturing techniques (such as batteries vs. solar) it is a much more difficult sector to pursue.

[2] Team LACI has detailed notes and, in some cases, audio recordings to document interviews, but are only available to Team LACI members to protect the confidentiality of the interviewee. Only anonymous attributions are included in this report to encourage open, frank, and honest discussion with interviewees.

[3] From the Warm Springs Innovation Center Feasibility Study RFP #17-006, "Innovation cultivators are companies, organizations or groups that support the growth of individuals, firms and their ideas. They include incubators, accelerators, proof-of-concept centers, tech transfer offices, shared working spaces, community colleges and universities advancing specific skill sets for the innovation-driven economy."

4. Combining Findings #3 and #4 leads to the conclusion that building a "Manufacturing Center of Excellence" with an emphasis on growth stage companies is a distinctive strategy that may have wide appeal. Among other things, this strategy leverages Fremont's history in semiconductor manufacturing, its current position as a leader in contract manufacturing, and its position as the home of one of the largest electric vehicle manufacturing plants in the world.
5. A network of resources, facilities, and equipment for the above sector verticals is critical. While the Bay Area and Fremont might have access to a variety of stakeholders with start-up expertise, there is no network for expertise in the manufacturing sector. The lack of connectivity within this industry is a barrier to growth stage companies looking to manufacture for the first time.
6. Fremont's challenge is its current perception as a bedroom community[4]. While Fremont actively supports innovation, this is not widely known. Moreover, Fremont is not typically viewed as a fun/youthful/cool place, which is key to building urban innovation centers.

[4] A bedroom community is a residential suburb inhabited largely by people who commute to a nearby city for work.

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2.0 Background

On May 12, 2017, Team LACI responded to the City of Fremont's Warm Springs Innovation Center Feasibility Study RFP #17-006, "seeking a multi-disciplinary team to conduct a feasibility study for the development of a half-acre City-owned parcel immediately adjacent to the new Warm Springs BART Station"[5] with a "primary objective of developing the site to add uses that complement the innovation activity occurring broadly across the WSIC, from Tesla's production of electric vehicles to bionic prosthetics."[6]

A kickoff meeting was held in Fremont on September 28, 2017. Presentations and discussions involved the following topics: Warm Springs Innovation District Development Updates, Intro to LACI's Ecosystem Model, Overview of Ecosystem Scan, and Overview of Real Estate Analysis. This meeting provided guidance for the interview process including the discussion guide and approval of the general approach for the project.

A second meeting was held in Fremont on November 29, 2017 to review work in process. This included a summary of 59 interviews with members of the ecosystem and an assessment of 50 relevant innovation cultivators active in the Bay Area. BAE presented its overview of the market, demography, and real estate. JFAK presented its initial massing studies and site analysis.[7] At this meeting, LACI presented and the city approved further investigations on manufacturing activities broadly, as well as a closer look at medtech and cleantech as sector focus areas.

This document provides an assessment and analysis of the current state of the Warm Springs ecosystem and identifies key findings, gaps, and implications, which will be used to develop programming for the potential innovation cultivator.

[5] RFP #17-006 Warm Springs Innovation Center Feasibility Study-FINAL, page 4.

[6] Ibid, page 6.

[7] BAE and JFAK's reports were a part of the Phase 1 Site Analysis deliverable.

3.0 Ecosystem Framework

LACI has learned that successfully monetizing ideas into enterprises is characterized by a rich and supportive ecosystem that goes beyond physical buildings and laboratories. Experience shows that successful innovation ecosystems are comprised of eight major contributing components, as depicted in the Ecosystem Framework graphic above. The framework is what LACI used to examine Fremont and identify gaps. Each component has attributes, such as space and programming that were examined and discussed. The following will provide the reader with more detail on each of the components found in Fremont and the surrounding Bay Area.

3.1 Sources of Ideas

Access to many local sources of ideation, creativity, invention, or disruptive alternatives is the critical foundation for any innovation ecosystem. Fremont is contained within the Bay Area, an ecosystem with a reputation for turning ideas into opportunity. These ideas may come from nearby research institutions, early stage acceleration programs, teams at nearby corporations, or many others across the Bay Area.

The Fremont metro area, including the Bay Area, has an abundance of ideation sources and receives billions of dollars in research money annually. Team LACI used the publicly available United States Patent and Trademark Office (USPTO) dataset[8] to garner insights on the originators of ideas (or patents) for the City of Fremont. The dataset scope was limited to Fremont patent assignees, which represented organizations who both operate and file for patents in the City of Fremont. Apart from looking at the year of filing, Team LACI also

[8] USPTO Dataset: http://www.patentsview.org/web/.

examined Cooperative Patent Classifications (CPC)[9], which classifies patents by specific technology areas. This information provided a better understanding of sector verticals, which a WSIC could support. Team LACI used the data to confirm the specific representation of hardware innovation in the city. Additionally, the team was also interested in finding data on smaller assignees to gauge the representation of start-ups and smaller companies within the city, which could also benefit from a WSIC. Finally, it should be noted that patents are an informal indicator of innovation. They are an output to a research and development process, but do not necessarily turn into new companies, innovation, or new products. They help indicate that there are sources of ideas in a community, which with the help of an innovation cultivator, could be turned into outcome based measures such as companies, jobs, and economic growth.

From 1977 to 2017, there were 11,007 patents assigned, with 5,732 of those patents published in the last ten years (Figure 1). Key players in the Warm Springs ecosystem, Tesla and Apple, were not included in this dataset as they filed outside of the City of Fremont, but they have filed 307 and 2,138 patents, respectively, in the Bay Area since 1977. Inventors who have filed in the city but with an assignee company outside of the city were also not included in this dataset.

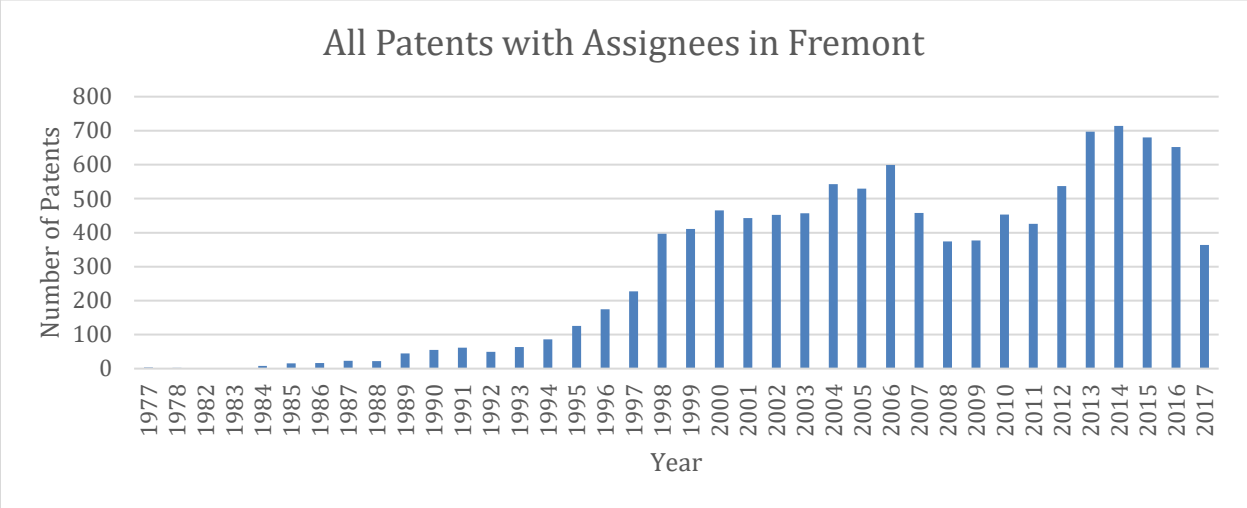

Figure 1: Number of Patents with Assignees in the City of Fremont.

Nine assignees within the city hold more than 100 patents, the largest holders being Lam Research followed by Western Digital. This compares to 165 assignees who hold a single patent, of the total 419 assignees represented in the group. Of the total number of patents, 53 percent are published by assignees who have greater than 100 patents (Figure 2).

[9] CPC Section Definitions: https://www.uspto.gov/web/patents/classification/cpc.html.

Approximately five percent of patents are held by assignees with up to five patents, and it is believed this group could represent some start-ups in the City of Fremont (Figure 3).

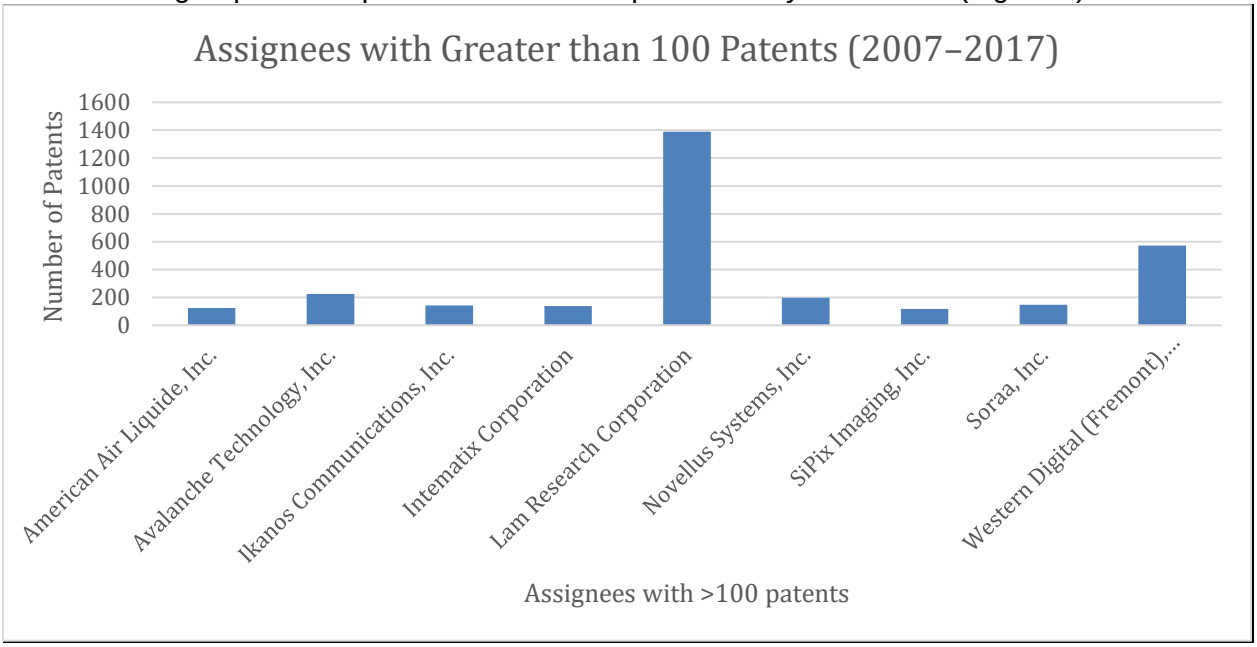

Figure 2: Patents by Assignee.

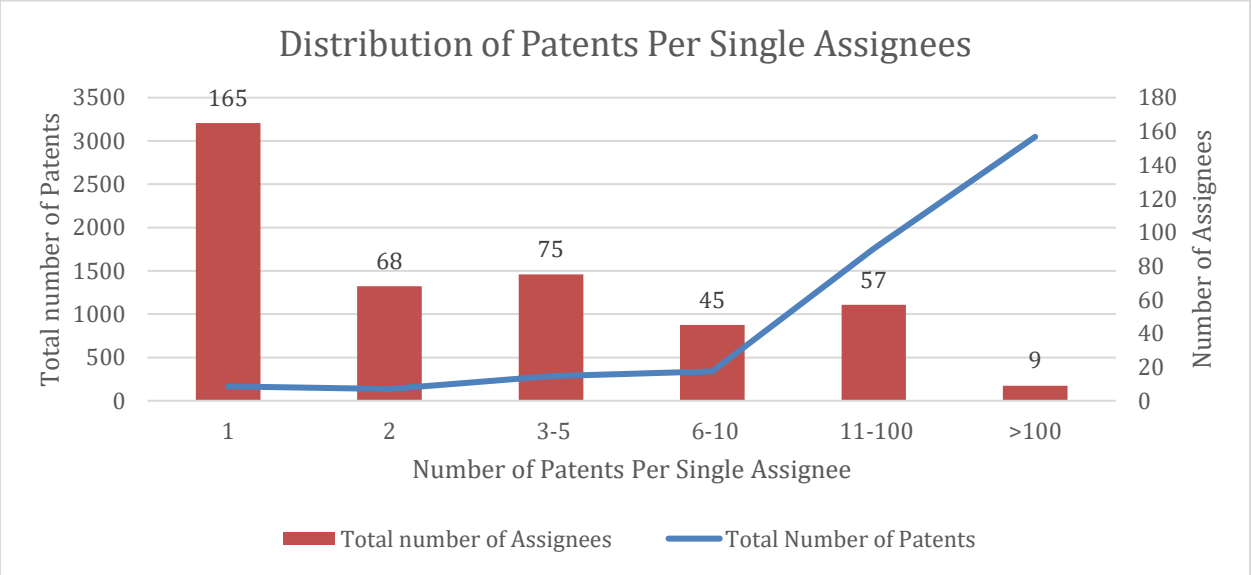

Figure 3: Distribution of Patents per Single Assignees.

The team also compared the technology focus areas of smaller assignees with less than two patents with larger assignees who held greater than 100 patents. In general, the largest focus

areas, almost in equal proportion, were Physics and Electricity, each representing approximately one-third of all patents for both small and large assignees. This correlation in technology areas between large and small assignees suggests that the size of an assignee does not affect focus area. One key difference was a larger proportion of patents related to Human Necessities in the smaller assignee category (11 percent) versus the large assignee category (2 percent) (Figure 4). It is believed that some patents pertaining to the biomedical industry are contained in this category and they have greater representation in the smaller assignee data.

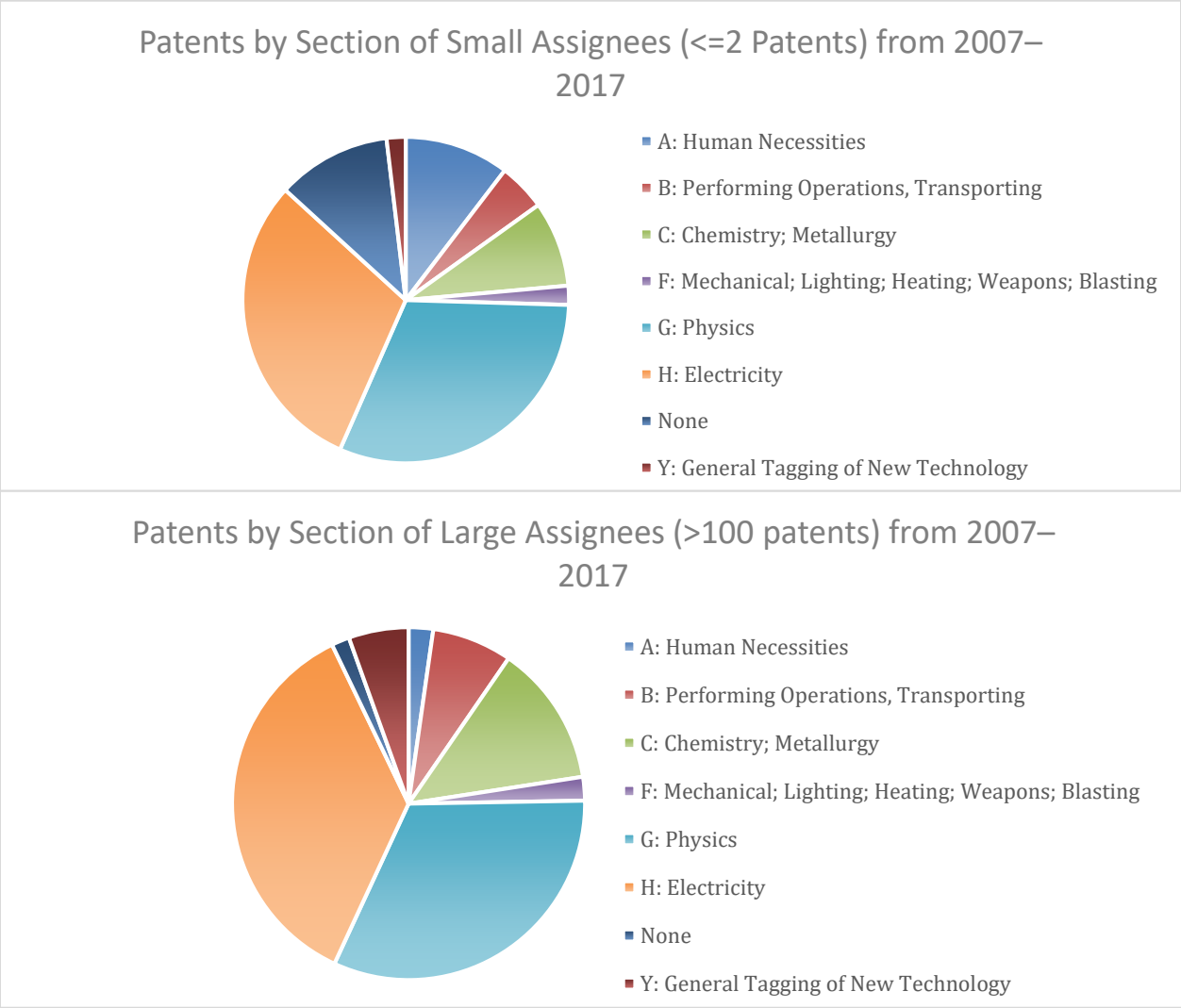

Figure 4: Patents by Large and Small Assignees.

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Further analysis of all patents suggests the largest groups are Physics, and Electricity and Chemistry/Metallurgy, with some increase in the Physics category over time. Looking at subset technologies within these categories, the largest categories relate to Physics are information storage and digital data processing, which makes sense given that Lam and Western Digital[10] are the largest patent holders. Other categories of note relate to optical medium elements and measuring electric/magnetic variables. Within the Electricity CPC, the largest subset categories relate to semiconductor devices, electric solid state devices, and electrical discharge tubes. Smaller categories of note relate to telephonic communications and battery processes. For the Chemistry CPC, the largest categories relate to coating metallic materials and chemical vapor deposition (Figure 5). Additionally, the large number of patents in the technology focus areas of Energy and Human Necessities support the recommendation for the WSIC to focus on energy and medtech device manufacturing.

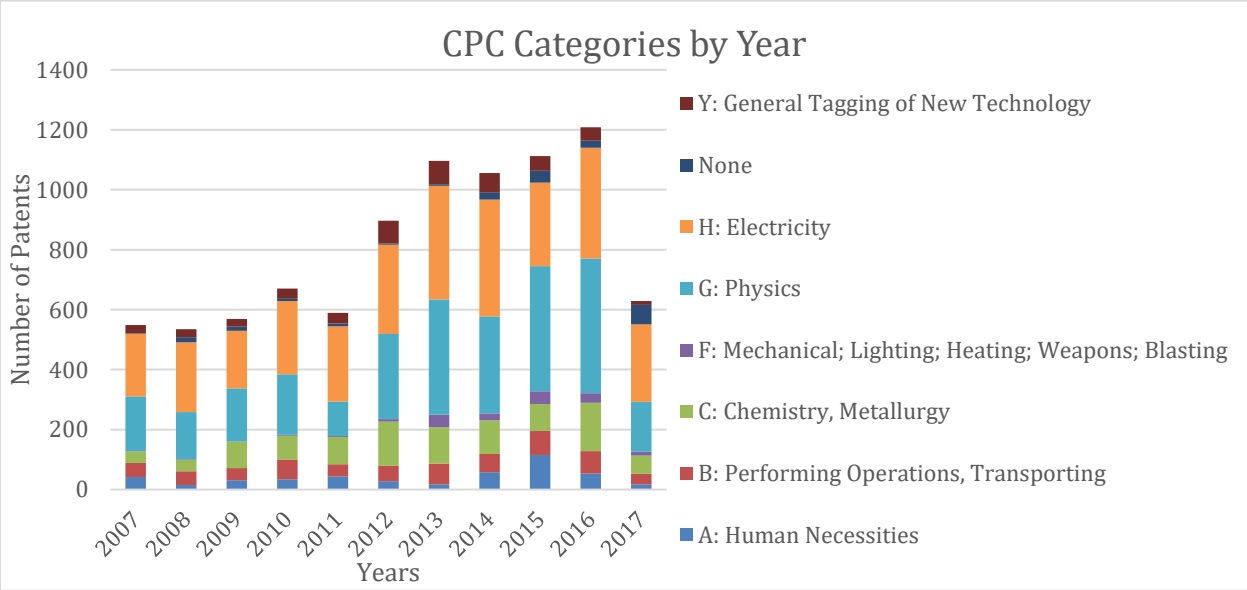

Figure 5: CPC Categories of All Assignee Patents by Year.

Patents are an indicator that there are sources of ideas in an ecosystem, but they do not necessarily translate into companies or jobs. The Fremont data identified that (likely) large companies are holding the most number of patents. These companies may not spinout new technologies into companies, unlike start-ups, which may be more likely to establish a company

[10] Lam and Western Digital are electronic device manufacturers.

based on their patents. Additionally, even with Fremont's rich history of manufacturing related to the semiconductor sector, interview feedback suggested that capital-intensive hardware start-ups, potentially originating from some of these patents or at these institutions, face challenges during manufacturing scale-up. Interviewees suggested additional training and mentoring in how to scale-up and finance manufacturing and related growth stage activities is needed in the Bay Area and many other parts of the United States. Yet, organizations in the Bay Area are beginning to recognize this gap.

The Bay Area hosts four Department of Energy (DOE) national laboratories: Lawrence Berkeley National Laboratory (LBNL), Lawrence Livermore National Laboratory (LLNL), Sandia National Laboratories, and the Stanford Linear Accelerator Center (SLAC) National Accelerator Laboratory. These laboratories have some of the strongest biosciences and clean energy research and development programs in the country. The recent launch of new federal programs has encouraged the labs to identify ways to spinout and commercialize their technologies. For example, in collaboration with the National Science Foundation (NSF), DOE launched its Energy I-Corps program, modeled after the NSF I-Corps, which helps scientists complete early market research of their technologies. Yet even with this program, there is a gap after the early stage commercialization activities and before the technology is ready to scale-up its production.

Many of the Bay Area universities have relevant programs as well as their own accelerators and incubators that support industrial innovation, some of which focus on the scale-up gap. One relevant example, highlighted by an interviewee, is the Stanford StartX accelerator program, which provides mentoring to both early and late stage medtech companies that have been spinning out innovations or patents from the university since 2011. This program has expanded to include cleantech, consumer, and enterprise IT as well as general hardware companies. With over 1,200+ Stanford entrepreneurs in the network, the program provides over $1.2M in-kind value without taking start-up equity.[11] University of California (UC) Berkeley also offers specific innovation courses such as the Cleantech-to-Market program, in which current students provide free commercialization support to early stage cleantech start-ups as a part of their coursework. Interview feedback indicated that the California State East Bay (CSUEB), which includes Fremont as a part of its territory, has a rigorous program to support the multidisciplinary field of medtech, and is well embedded to support a thriving medtech community in the East Bay. CSUEB has satellites in the other parts of the East Bay and expansion into Fremont would strengthen its presence in the community and across the East Bay.

[11] https://startx.com/accelerator.

Several other incubators and accelerators, mentioned by interviewees, are affiliated with Bay Area universities and the labs. For example, Skydeck is an accelerator associated with UC Berkeley, Cyclotron Road is an energy-related incubator at LBNL, and QB3 is a biotech and medtech incubator associated with three local California universities. These incubators and accelerators generally foster innovation at the early stage and could be used as collaborating channel partners for the WSIC if it is focused on helping the same companies manufacture their products and scale their companies.

The number of energy specific cleantech and medtech device patents originating in Fremont, plus the availability of supporting university programs focused on spinning out technologies in these sectors demonstrates that sources of ideas in Fremont is not lacking.

3.2 Innovation & Entrepreneurial Support

The Bay Area innovation ecosystem has a plethora of innovation cultivators as well as start-ups interested in receiving services from these cultivators. As Leslie Berlin stated about Silicon Valley's ecosystem in her 2017 book, *Troublemakers: Silicon Valley's Coming of Age,* the

> "…ecosystem comprising more than 3,000 Silicon Valley firms had evolved to provide businesses with start-up expertise. These venture capitalists, chip designers, glass blowers, fabrication houses, dye cutters, equipment suppliers, and specialized law, recruiting, and public relations firms were themselves entrepreneurial ventures. They helped launch a new generation of entrepreneurs many of whom built on the breakthroughs and precedents set by the troublemakers who had come before."

By the end of the Phase 1 of Team LACI's investigation, the team reviewed 50 innovation cultivators in the Bay Area, yet many more were identified through interviews, events, and other avenues. Additionally, new innovation cultivators seem to be announced regularly.[12]

Team LACI considered various dimensions of programming, site attributes, focus areas, business structures, and other relevant dimensions identified in the Team LACI Ecosystem Framework. The most relevant cultivators surveyed are concentrated in San Francisco and Oakland. Other cities throughout the Bay Area usually have at least one innovation cultivator, including two in Fremont. However, the cultivators in Fremont are only co-working spaces and

[12] Appendix 5.3 for the list of 50 innovation cultivators reviewed.

do not provide any innovation programming. All other major cities have at least one innovation cultivator with programming (Figure 6, next page).

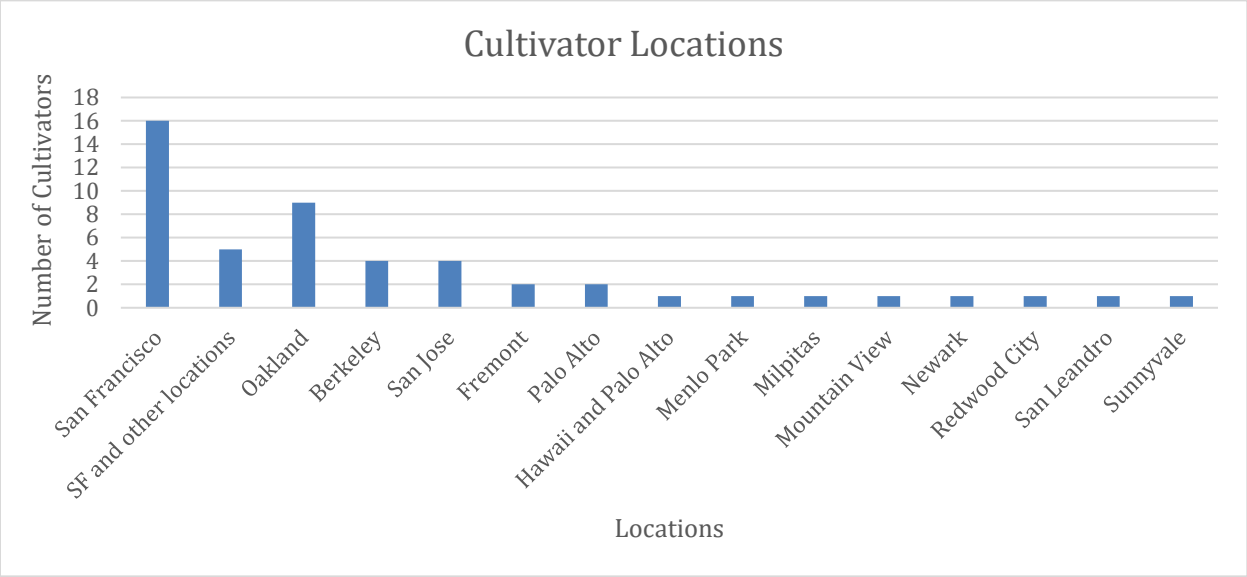

Figure 6: Cultivator Locations. Five cultivators have multiple locations in addition to their San Francisco location. One cultivator has locations in both Hawaii and Palo Alto.

Assessed attributes of innovation cultivators include incubator or acceleration services, makerspaces, networking opportunities, training programs, co-working facilities, and event space.[13] Specifically, space such as makerspace and event space are important to the development of an innovation cultivator. Depending on the industry and the objectives the innovation cultivator is trying to achieve makerspaces are areas where key early stage activities such as prototyping can take place. The process of iterating on a prototype as a startup is learning about the needs of a customer is critical to the product development cycle. As discussed in the Facilities section of this report, a makerspace may not be as important to later stage startup companies. Similarly, event space is critical for bringing a community together. It will be needed as a central gathering place for leadership events, roundtables, or other activities that may bring different stakeholders together around a central theme. Programming attributes are also important. These are the services provided to the community, the potential startups, and other private sector partners engaged with the innovation cultivator. Programming will be highly dependent on the objectives of the cultivator. Thirty-three innovation cultivators do not have a sector specific focus area and, if they do, they often accept other technologies into their facilities. Areas of focus for some of the innovation cultivators include everything from electronics to energy to cannabis (Figure 7).

[13] Additional information on space can be found in Section 3.3 (Right Facilities).

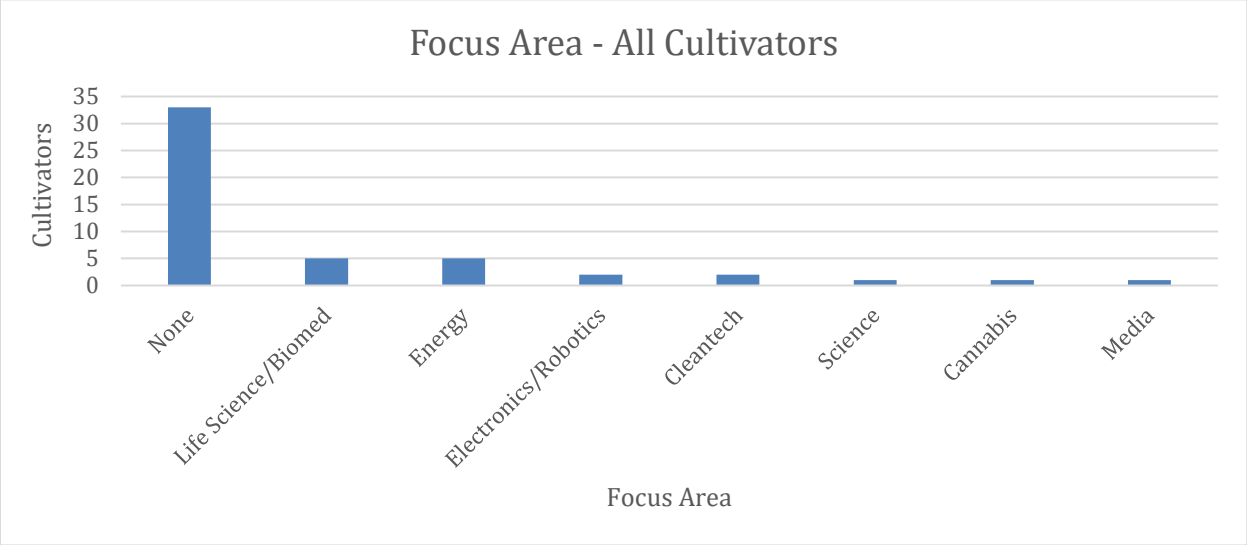

Figure 7: Cultivator Count by Focus Area (with and without Makerspaces).

Of the innovation cultivators reviewed, 20 of them have some kind of makerspace. Seventeen of them focus on developing hardware technologies up to their first prototype and do not provide much assistance on how to mass-manufacture. The other three—Flex, HAX, and Highway1—provide manufacturing scale-up assistance, but most programmatic elements seem to focus on how a start-up can outsource their manufacturing to another country. Notably all four of the life sciences and only two of the four energy-related cultivators have makerspaces (Figure 8).

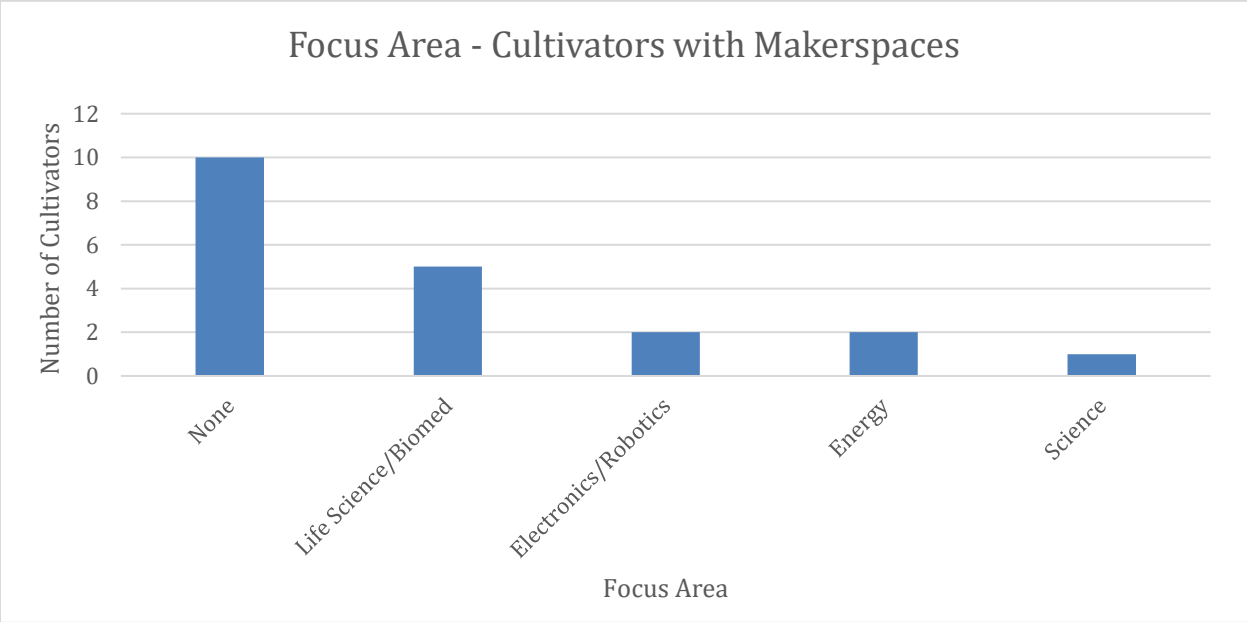

Figure 8: Cultivator Count by Focus Area with Makerspaces.

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Finally, given the strong venture capital (VC) focus of Silicon Valley, it is not a surprise, that 38 of the innovation cultivators are private organizations, many of which have venture capital connections (Figure 9, next page).

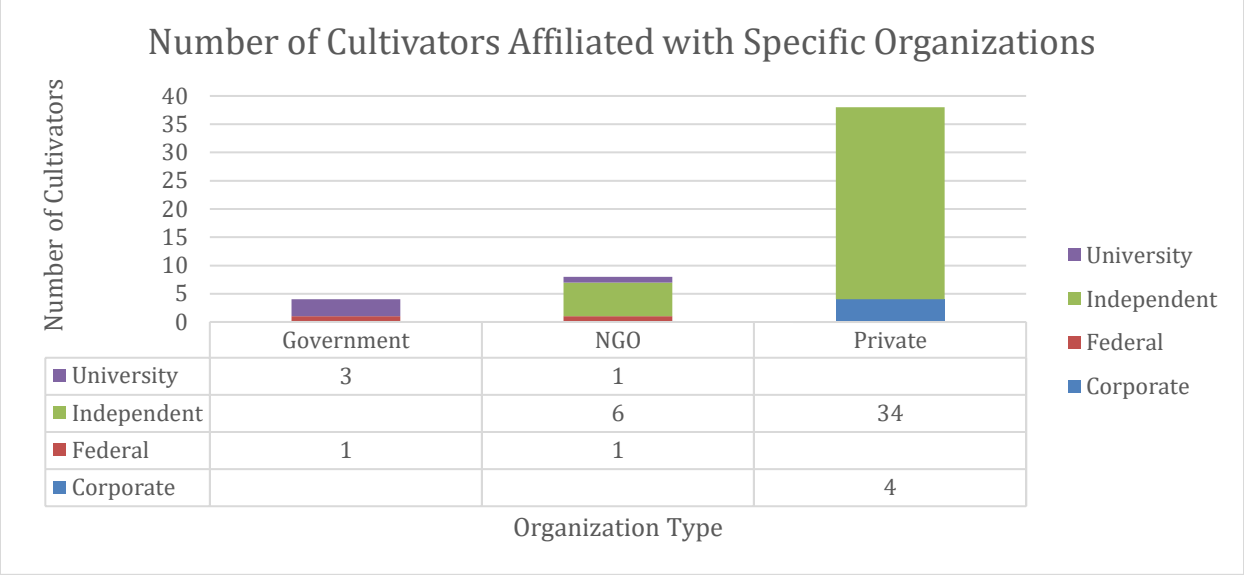

Figure 9: Affiliation/Organization Type.

Analysis from Phase 1 of the Fremont workforce, demographics, economy and city reputation lead the team to focus its attention on manufacturing scale-up, with specific verticals in medtech devices and cleantech. With this lens, a deeper dive was conducted on 13 innovation cultivators, 10 from the Bay Area and three which focused on manufacturing or energy from across the country.[14]

In this deeper dive, the team found that many of the existing innovation cultivators focus on early stage start-ups that need to develop a business plan, understand their markets and their customers, and develop their first working prototype. There are few organizations in the Bay Area focusing on how a start-up moves from a working prototype into mass manufacturing. As stated above, some examples do exist, such as Flex, HAX, and Highway1, but most of these organizations focus on how a start-up could outsource their manufacturing to another country. This activity doesn't meet the city's desired goals for economic development. In contrast, our review of Greentown Labs found that they have developed programming and partners that help companies mass manufacture both in the United States as well as abroad. This demonstrates

[14] See Appendix 5.4 for Innovation cultivator summaries.

that Fremont could help fill the Bay Area's ecosystem gap by developing expertise and facilities that help a start-up design and manufacture their products.

Interviewee discussions support this analysis. Feedback suggestions often centered on filling the gap in manufacturing expertise by utilizing programming similar to what Greentown Labs offers. Fremont was identified for having mentors with experience in design for manufacturing, regulatory requirements, sourcing, engineering, and many other skills necessary to fill this gap. Additionally, interviewees explained that quick and easy access to support services such as accounting, human resources, public relations, marketing & web development, IT services, insurance, and real estate advice is lacking for later stage hardware companies, yet many of these services are already located in Fremont.

3.3 Right Facilities

Matching facility design and capabilities to business sector requirements is key. A media lab won't be of much use for an energy storage company nor will a chemistry lab be relevant to a mobile app company. From this perspective facility design is strategically important. Team LACI considered various dimensions of each innovation cultivator with specific attention paid to site attributes like makerspaces, co-working areas, and event spaces. Almost all, 74 percent, had some kind of shared co-working space. Conversely, only 44 percent had event space (Figure 10). These spaces are important to the development of communities where innovative ideas can be developed and shared.

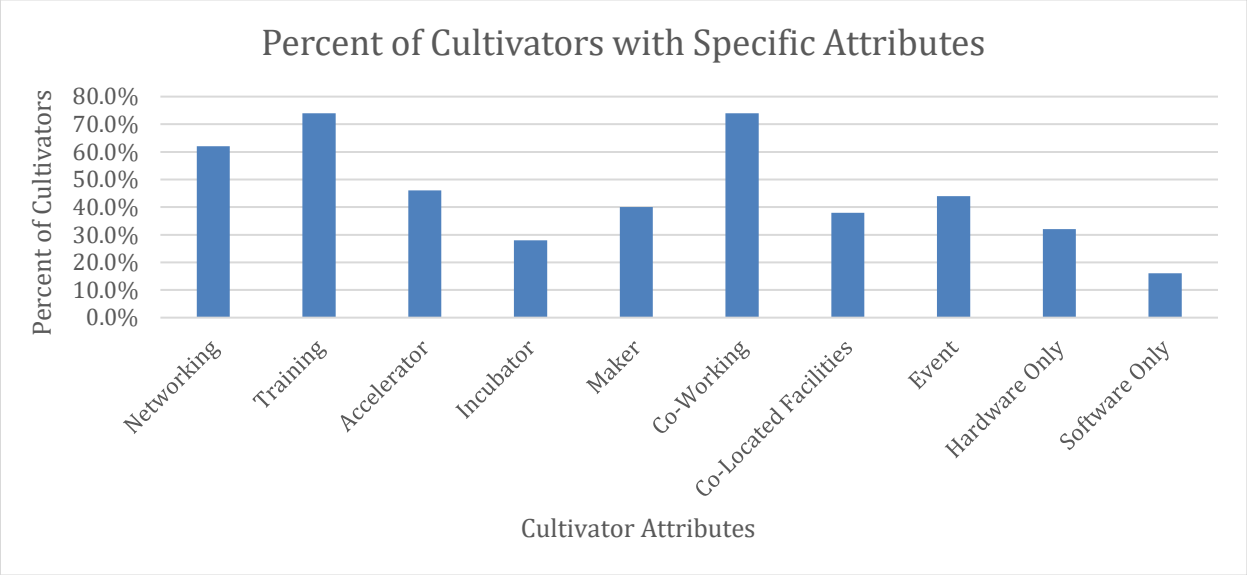

Figure 10: Cultivator Attributes.

Additionally, after narrowing the focus of the WSIC to manufacturing scale-up, with verticals in medtech devices and cleantech, Team LACI took a deeper dive into specific makerspaces that are needed for the development of these hardware technologies. This is critically important because these sectors require the development of physical products, which necessitates a different kind of space. Of the 50 innovation cultivators reviewed, 20 of them had makerspaces. This included everything from CNC machines, 3-D printers, wood, metal, and textile shops, electronics labs as well as test kitchens. No makerspaces were identified in Fremont. Focusing on manufacturing helped the team identify that only one innovation cultivator, Flex, specifically had space for pilot line development or assembly. Other innovation cultivators had larger lab or prototyping space, but depending on the product they may not have had enough space for assembly. Some interviewees identified flexible manufacturing and assembly space as an important characteristic for innovation cultivators, while others stated that when companies get to the scale-up stage, they may be too big for shared manufacturing space.

Makerspace needs will be dictated by the individual companies. For example, one interviewee stated that providing start-ups with low cost assembly space that could be leased on a month-to-month basis would bridge the gap before they go to a contract manufacturer and is more important than makerspace. Cyclotron Road, housed within Lawrence Berkeley National Laboratory, has the best and most unique makerspaces available to its start-ups, which dictate the need for certain kinds of equipment for companies focused on early stage hard science. This special arrangement with the lab means its start-ups have access to billions of dollars' worth of world-class facilities and equipment such as high-performance computers, nanotechnology labs, light sources, sequencing machines, wet labs, and numerous other unique facilities. After Cyclotron Road, QB3 has the most extensive makerspace with five locations across the Bay Area and a variety of spaces and equipment accessible for rent. Additionally, some innovation cultivators like Prospect Silicon Valley and NextEnergy in Michigan also have significant demonstration and test capabilities. Notably all four of the life sciences and only two of the four energy related cultivators have makerspaces.

Our real-estate analysis identified a few barriers to the growth of innovative companies in the Fremont market. These companies are looking for office space, access to commercial and retail activities, and event space. For example, Team LACI found that of existing commercial inventory only four percent, or 6.9 million square feet, in the district is commercial, 80 percent industrial, and 16 percent flex. Vacancy rates are less than one percent and office inventory has no vacancies. Retail space is available (12 percent vacancy rate), but convenience retail has no vacancies. Additionally, Fremont and Milpitas have the smallest inventories of Class A Office Space in Silicon Valley (884,342) with an 11.7 percent vacancy. Finally, Fremont and surrounding communities have few suitable locations for corporate events. What is available

(100–300 people) lacks high-end finishes, flexible layouts, and audio-visual equipment. Interviewees stated a lack of these kinds of spaces deter start-ups from moving to Fremont. There is optimism from some brokers because of the proposed commercial development projects, which will more than double space to 13.9 million square feet, mostly industrial and flex, which will be good for companies looking to build their first pilot lines in the area.

As stated above, having makerspaces could be critical to the success of the WSIC. However, since there are over 20 makerspaces already in the Bay Area, creating a new one may not be necessary. Yet, it is important to point out that most existing cultivators focus on early stage start-ups, which often need assistance with their first prototype, but additional assistance on how to scale production is lacking in most innovation cultivator programs. Through the interview process, Team LACI confirmed that the business model around makerspaces can be complicated, especially when an audience is significantly diverse. We specifically heard from one interviewee familiar with the TechShop business model that there was a mismatch between the service and equipment provided and the audience that the organization attracted. This mismatch ultimately led to the demise of TechShop. Additionally, equipment quickly becomes outdated so investing significant money into both capital and operating cost may be detrimental to the long-term viability of a makerspace in Fremont. In addition, traditional equipment such as 3-D printers aid start-ups with prototyping but are less useful at the scale-up stage.

To overcome some of these pitfalls, innovation cultivators have looked to different business models for access to makerspaces. For example, a few of the Bay Area innovation cultivators, Bolt and Lemnos Labs, outsourced their makerspaces to other organizations that they share locations with. This may be difficult given that there are no makerspaces in Fremont. Another model is to have a shared makerspace, such as LACI's Advanced Prototyping Center. The APC is now open to the local community, either for K–12 students or to local residents, interested in manufacturing. These audiences have different needs, but if done right, could supplement the funding needed to support a makerspace for start-ups.

Another way to achieve the same services provided by a makerspace is to find a way to create a network of space and equipment that can be tapped into by start-ups. This is what the Engine did in Massachusetts and what IndieBio states that it can do for its start-ups. The Engine has its Engine Room, which is a network of tools and equipment in the area that can be used by the Engine companies. Partners of the Engine include The Broad Institute, Lincoln Laboratory, Center for Nanoscale Systems, Microsystems Technology Laboratories, Computer Science and Artificial Intelligence Laboratory, and Massachusetts Green High Performance Computing Center. This network concept was supported by some manufacturers interviewed by Team LACI, but they also noted that legal and liability issues would need to be hashed out.

Finally, Team LACI found a significant lack of event space in the Fremont area and across the innovation cultivator community. This data was also backed up by BAE's real estate analysis which was submitted as a part of Phase 1.[15] Based on LACI's experience with its event space at the La Kretz Innovation Campus this kind of space is critical to putting together the right programming and creating the innovation ecosystem for multiple stakeholders to interact.[16] Using NextEnergy as a model, the center could create a number of different event spaces that could be multi-use and flexible depending on the needs of the organization and its stakeholders. NextEnergy has significant conference and event space for rent as well as co-working areas and a common kitchen. This includes 10,000 square feet of leasable event space including a 122-person auditorium, a 300-person auditorium, and a 60-person conference room. They also have 18,000 square feet of built-to-suit, leasable lab space.

Focusing on the strategies above to create the right facilities that align with later stage start-ups going into pilot line development and mass manufacturing will be essential to the success of an innovation cultivator in Fremont.

3.4 Sources of Capital

Silicon Valley is world renowned for its concentration of tech and life sciences innovation as well as the funding ecosystem that it has developed to support venture development. The area is consistently ranked highest in geographic ratings for the availability of start-up venture capital. While a large portion of available investment dollars have recently been focused on less asset-intensive businesses in software and media solutions, investors focused on more asset-heavy businesses such as cleantech and medical devices to remain active in the region.

A Brookings study[17] from May 2017 found that over the last several years, much of the cleantech investment activity has consolidated in San Francisco, San Jose, Boston, and Los Angeles. With two of these four geographic investment hubs in the Bay Area, Fremont is well positioned to be an international hub for cleantech businesses, many of which are manufacturing centric.

[15] As a Phase 1 deliverable LACI prepared a real estate and market analysis. This included market research, such as rental rate and vacancy trends and planned and proposed project data for office, retail, education and hotel uses. It also included land valuation information.

[16] See more info on events in Section 3.7 (Leadership Council).

[17] https://www.brookings.edu/research/cleantech-venture-capital-continued-declines-and-narrow-geography-limit-prospects/

Given the focus on growth stage start-ups, it is expected that most companies engaging the WSIC will have already secured Series Seed and potentially Series-A funding from the investment community. It is likely that while the programming efforts of the WSIC should include investor engagement, these existing relationships of portfolio companies can be leveraged to build the center's investor rolodex. Such investors and their extended networks can be leveraged to source follow-on venture investment for the portfolio companies as they scale. While this may be the case, some interviewees noted that many venture investors encourage start-ups to outsource their manufacturing to other countries, a potential concern for Fremont.

Less prevalent in the current investor ecosystem are connections that provide cost effective access to later stage capital and financing mechanisms. In 2013, the City of Fremont, the Fremont Chamber of Commerce, and Grow California published the Innovation Scorecard.[18] It notes four major impediments for growth stage companies, one of which was "access to late stage venture capital and private equity." It goes on to say that, "Fremont can generate many positive outcomes by proactively addressing the four impediments, including establishing a number of competitive differentiators as a community, such as becoming known as a hub for private equity and later stage capital."

Later stage investors have different parameters than early stage investors. Later stage capital sources expect a historical quantification of performance combined with higher expectations on the accuracy of projections. They can commit larger, and sometimes more patient, capital resources. Especially for manufacturing companies, which are purchasing assets that can be collateralized. These different, sometimes more complex, business models require a different kind of investor with unique expertise in operational issues and a greater understanding of market opportunities. Interviewees described how large manufacturing companies who understand these operational issues, such as Flex, could be open to this kind of later private equity investment. Another interviewee suggested something similar, where East Bay manufactures could join forces and create a fund to assist early stage companies interested in manufacturing in the region.

As the WSIC portfolio companies scale manufacturing, these companies will also need access to cost effective sources of working capital. Companies in this stage are often pre-revenue and therefore do not qualify for typical lines of credit. Existing bank programs and even the U.S. Small Business Administration lending programs typically require a history of positive cash flows before they will lend to such companies. In the past, the DOE provided early stage loan

[18] https://fremont.gov/documentcenter/view/19545

programs that helped companies address this gap. While this program still exists, it now services later stage companies that can prove credit-worthiness.

Venture debt firms in the area do service such needs but often at significant cost. Silicon Valley Bank, Socket Capital, and other venture debt firms are target partners for such programs. In addition, ecosystem members have been actively developing new programs to fill this gap. The New Resources Bank and other mission-driven community lenders have launched funds to service impact oriented companies. Funded by the DOE, LACI has also launched a “Capital Access Program” with community development financial institutions to direct a portion of their capital to growth stage companies that exhibit strong impact potential. In building its investment programs, WSIC can partner with these firms to provide an array of capital solutions for their portfolio companies.

The Bay Area has an abundance of capital resources that are accessible to companies located in Fremont. From very early stage angels through to professional investors and commercial banks, there is no gap in sources of funding, but mostly for software companies. Within the specific focus of growth stage manufacturing companies, there is a need to improve access to sources of private equity and working capital.

3.5 Stakeholder Engagement

The existence of small, medium, large, and global multinationals in and around Fremont provides the foundation for collaboration between companies. A robust and vibrant group of stakeholders actively involved with the ecosystem’s technologies is one of the primary accelerants for technology commercialization. These groups can take many forms, from “clusters” to “meet-ups” to industry associations. They all can serve the role of convener and catalyzer. This is where entrepreneurs can make and develop the relationships that are critical to their success.

However, several interviewees mentioned that there is no broad network in the Bay Area to connect start-ups to contract manufacturers and other manufacturing resources, especially those in the East Bay. Feedback indicated that while there is a rich network of universities, start-ups, corporates, and incubators, they are not necessarily well connected for manufacturing purposes. Manufacturing success requires a connected network of suppliers, designers, and consultants. Further feedback highlighted that only certain manufacturers are willing to work with start-ups at the pilot scale. This is due to the perceived lack of value from a smaller contract versus the work required to get a start-up’s prototype ready for manufacturing. Currently, there is no resource guide or network of mentors to help start-ups identify those partners who are best suited to their needs and current stage of growth.

Several interviewees highlight that the best connected industry networks make use of "champions" or "sherpas" who are able to provide contacts across the value chain of a particular vertical. One interviewee stated that a list of contacts online or even a maintained network database is insufficient to establishing real meaningful contact to industry partners. Sector-specific champions should be employed by the WSIC who both understand the strategic direction of the industry and have a depth of understanding of the local players. Such champions would serve to provide a matchmaking function within a particular vertical, a function which requires greater depth of knowledge than simply marketing an early stage start-up. Interviewees stated that there are individuals within the Fremont community that play this role on an informal level, but this connecting and coordinating activity is not a full-time position nor is it being conducted with a specific economic development strategic vision. Information from interviews identified the medtech industry, which is already somewhat connected, as ripe for additional coordination and strategic networking. Interviewees stated it would be the perfect candidate vertical, as it is a close-knit community where players attend trade shows and events, and introductions are frequently through word-of-mouth. The cleantech sector was also identified, but no single individual is currently engaged across the breadth of technologies such as solar, batteries, or energy efficiency. Team LACI considers identification of these champions and the formation of a networking organization critical to ensuring the success of matchmaking start-ups to manufacturing resources. Some interviewees familiar with Cleantech Open's Western Region identified this organization and its mentor network as a good starting place to organize additional stakeholders and focus programming on challenges in manufacturing.

Interview feedback suggested that stakeholders with business services should be connected to the WSIC. Services from stakeholders could include specialty banking for start-ups, access to VCs who understand manufacturing, and potentially workforce development resources. Interview feedback from corporations in the area seemed to suggest they had interest in attraction and retention of manufacturing workforce. One specific area of concern for many interviewees is the lack of understanding of the DFx (design for x) suite of methods. LLNL developed a Build 4 Scale[19] curriculum to aid in clean energy hardware manufacturing scale-up. A partnership could be developed with LLNL to bring that curriculum to Fremont. There are other organizations that exist in the Bay Area that can be relied on for support such as Manex (which provides manufacturing consulting) and SF Made (an organization supporting locally made products). There can also be creative networking methods encouraging start-up innovation, which are not capital intensive. For example, Local Motors uses the "Launch Forth" online design competition to source innovative ideas in automotive design. These stakeholder

[19] https://www.llnl.gov/news/llnl-lead-development-manufacturing-training-program-energy-entrepreneurs

groups coordinate, convene, communicate, and can promote the WSIC activities to the community, partners, sponsors, corporations, and governing bodies.

Additionally, interviews indicated a strong community of participants that are willing to engage and support the evolution of the WSIC. Individuals and companies share an interest in assisting in developing the Fremont area as a center of excellence. Stakeholders, including potential participants in the WSIC, become aware of each other through a robust communication campaign delivered via a variety of media. The "Think Fremont" campaign and the "Think Silicon Valley"[20] website are good starts at positioning Fremont as "…the city that's not afraid to roll up its sleeves to help companies start and grow their business." However, an awareness of the media campaign was not volunteered by those interviewed. While it is likely that its impact is real, especially among those who are choosing to act on the premise of the campaign, a stronger marketing system developed with the stakeholders, combined with the beginnings of programming including expanding events targeting those companies in growth and expansion modes, should become a priority.

Finally, most interviewees not already engaged with the City of Fremont, perceived the city as a "bedroom community." They had no historical context of the role that the city has played in manufacturing nor do they understand that the city currently has a strong manufacturing base. The city lacks the "cool" appeal that many innovation companies are looking for, especially in the Bay Area. This argues not only for a strong marketing campaign, but additional actions by all stakeholders to establish interesting retail, events, and other activities to attract innovative companies.

3.6 Policy Support

In many business sectors, government policies can drive markets or slow technology adoption. While this often occurs at the state and federal levels, cities can also develop policies that spur economic development for technology commercialization. City agency purchasing power, redevelopment ordinances, and locally-produced incentives are just a few examples. Connections to the local, state, regional, national, and international organizations that craft, frame, monitor, and govern are key in many emerging sectors. While the WSIC will not be structured as a policy or lobbying organization, it will be important for the center to engage local, state, and federal stakeholders in creating the market signals that will attract companies to Fremont and help drive deployment and adoption of the technologies being developed and manufactured in the city.

[20] https://www.thinksiliconvalley.com/

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Cities around the world are experimenting with policies to encourage innovative activities, acquire talent, recruit companies, initiate programs, provide facilities, and generate new revenue. For example, cities are often the front lines for mandating, purchasing, and deploying new energy, water, transportation, and other technologies that will impact their residents and the local environment. To attract innovative companies, it will be beneficial for the WSIC and the City of Fremont to build a reputation of leadership in promoting and deploying such solutions. An Accenture study[21] on creating an environment for the testing and adoption of new technologies recommends several courses of action cities and organizations can take. Recommendations include signaling commitment, leveraging owned infrastructure as test and demonstration sites, being comprehensive in supporting entrepreneurship, and using soft power to influence area companies to do the same. These actions would resonate with interviewees, who highlighted the need to demonstrate late stage technologies. Additionally, feedback gathered from the interviews also identified policies, which could provide some flexibility in siting, and how leasing of space to pilot scale manufacturing would be attractive to start-ups.

From our interviews, Fremont and its leadership are seen as active in supporting entrepreneurship and economic development and have visibility at events for start-ups and small-scale manufacturing. While some interviewees mentioned concerns about the state tax burden, increasing congestion, traffic, and access to affordable housing, the City of Fremont and its economic development team were frequently positively mentioned in their collaborative approach to enabling innovation and business success.

3.7 Leadership Council

It is common practice among non-profits and innovation cultivators to invite influential and well-connected organizations and individuals to serve in an advisory capacity through councils, boards, panels, and committees. These individuals help guide the strategy of the organization and provide connections that can assist with funding, partnerships, and other opportunities that advance the mission of the organization and benefit its portfolio companies.

One individual interviewed discussed the need for a strategic series of events with very high-level speakers focused on critical issues within the community. An example of this kind of activity is the LACI Leadership Council which began as an exclusive group representing the most committed and capable leaders in cleantech from the private industry, government, and academia in Los Angeles. Leadership Council meetings are held quarterly in which the group participates in programming meant to facilitate the connections that strengthen and grow the

[21] https://www.accenture.com/us-en/insight-outlook-innovation-cities

Los Angeles area cleantech ecosystem. Members pay an annual fee and include the innovation offices of four major universities, members of the LA Mayor's office, representatives from LA County and innovation leaders from area utilities, transportation and water companies. The group was instrumental in the formative years of the organization and helped provide key sources of funding and partners, a strong pipeline of start-up companies, and a source of highly qualified business professionals that donated time in mentoring member start-ups. As LACI further developed programming for the start-ups, several of these Leadership Council member organizations also became test and demonstration sites for the innovations developed by the start-ups.

Bringing together public policy makers, private sector leaders, and other interested parties can be a critical factor in successfully building momentum for an innovation cultivator. For the WSIC effort, a similar approach can be followed. The community has a very robust group of potential members who are focused on manufacturing technologies. Strategically focusing a Leadership Council on cutting-edge manufacturing technologies, practices, or other related issues would garner the attention of local stakeholders. Interviewees identified the following areas as potential manufacturing topics for discussion or demonstration: industrial internet of things, machine learning and artificial intelligence, advanced sensors, high-performance computing, and robotics. Strategic partners and funding opportunities, local manufacturing, and manufacturing consulting organizations as well as local multinational corporations can be tapped as speakers or sponsors for these events. Other targets might also include real estate firms that specialize in placing growth stage companies and investment firms that focus on Series B and later funding as well as firms that specialize in debt programs.

3.8 World Market Connections

The Bay Area is located in the heart of technology innovation. Most global companies have some kind of presence in the area. The same is true of incubators and accelerators, research and development (R&D) centers, and sources of capital. Moreover, manufacturing is a discipline that must be practiced on a global scale as everything from supply chains to new manufacturing technologies are occurring globally. There are manufacturing centers of excellence in universities, research labs, and corporate R&D labs around the globe. No single location has a monopoly on best practices, therefore every practitioner in manufacturing, especially those in the growth stage, needs to keep up to date on the newest practices, technologies, case studies, supply chain innovations, and financial models from across the globe.

All manufacturing companies go through a decision making process where they must identify where each part of their product is going to be manufactured and assembled. There was feedback from some interviewees that although manufacturing is currently occurring in Fremont,

it is “not necessarily innovative.” Advice for manufacturing start-ups in the recent past has been to develop a prototype of their product, then take the product to a regional manufacturing hub in China (Shenzhen) for piloting and contract manufacturing scale-up. There is a view that manufacturing innovation is happening in China, with Shenzhen viewed as a “one stop shop” for quick prototyping, piloting, and manufacturing scale-up. The contract manufacturers in the city are networked and resourced in such a way that getting a product produced there is perceived to be faster and cheaper.

Though overseas manufacturing may be cheaper and faster for some products, there is a growing sense, for both start-ups and innovative manufacturing companies, that producing their products in the United States may be a better option for some companies and some products. Some interviewees described how products with complex design requirements or originating from sensitive intellectual property may in some instances be cheaper, more efficient, and safer to manufacture in the United States. Additionally, the benefit of being local to the original design team is very useful and leads to less design iterations and economic losses during the initial manufacturing prototyping and piloting scale. However, interview feedback from a local manufacturer suggested that Fremont has lost a significant portion of its manufacturing intellect and may struggle to fill the specific gap of pilot scale manufacturing. Yet, other interviewees identified local resources such as some VCs, SFMade, and Manex as stakeholders, which could support a growing innovative manufacturing base in the city. Additionally, the numerous multi-national corporations located in Silicon Valley could be engaged to gain a better understanding of innovative manufacturing practices adopted aboard. One interviewee offered their own manufacturing space to help young innovative companies learn about new production practices. This same interviewee stated that it conducts its own R&D near its manufacturing pilot-lines, but after scale-up, and when appropriate, it mass manufactures its products abroad.

4.0 Summary

The above analysis documents that the City of Fremont has many of the elements needed to become a world-class center of excellence in manufacturing. It describes an opportunity where the city can align and connect its manufacturing resources, stakeholders, and intellectual capital to fill a gap in the broader Bay Area innovation ecosystem. It already is becoming the center for medtech and to some extent cleantech manufacturing. Additional efforts to provide services, programming, access to makerspaces, and flexible assembly spaces will go far in enhancing the city's attractiveness to start-ups. Hence, when compared against the benchmarks used in our Ecosystem Framework, Fremont does not have any glaring weaknesses.

Yet, the absence of a negative does not necessarily mean there is a presence of a positive. Five months of study yields an overall feeling that economic development initiatives driven by innovation hubs is a very competitive marketplace. Every city wants to be an innovation center. While Fremont has no significant weaknesses as a potential center for innovation, it needs a strategy that differentiates it from the rest and shows that it is capable of successful implementation. The city can be transformed into a vision of late stage start-up innovation for manufacturing. Nevertheless, making this a reality requires a commitment. Moreover, with that commitment, a communications strategy targeting those that share this vision and can assist in its implementation.

But other communities, worldwide, see the same opportunity and have similar aspirations. In 2014, Bruce Katz and Julie Wagner pointed out that, "…innovation districts are emerging in dozens of cities and metropolitan areas in the United States and abroad and already reflect distinctive typologies and levels of formal planning."[22] It does not yet appear evident that the world at large recognizes the leadership that Fremont demonstrates in manufacturing or innovation. This report indicates a major opportunity to fill an information gap, clarify the Fremont brand, and build awareness around its unique manufacturing capabilities and ambitions. Guided by a strategic branding perspective, developing and delivering programs that announce Fremont's intent to become a center of excellence in manufacturing can start now. There is no need to wait for space to begin program implementation. More important than space is a coordinated, continuous stream of activities, events, and accomplishments led by the city and in collaboration with local manufacturers.

[22] Katz, B. and Wagner, J. "The Rise of Innovation Districts: A New Geography of Innovation in America." Metropolitan Policy Program at Brookings; May 2014.

5.0 Appendix

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Brookings Institution

Martine Neider, CEO
SFMade

Marvin Remmich, Broker and Owner
RAM Properties

Maurice Robinson, Principal
Maurice Robinson & Associates

Maximilian Eils, U.S. Western Region head
EOS (3-D Printer)

Megan Brewster,
VP for Advanced Manufacturing
Launch Forth

Melissa Uhl, Chief of Staff
Elemental Excelerator

Michael Nathan, Partner
IBM Ventures

Mike Biddle, Managing Director
Evok Innovations

Neal Greenberg, Co-Founder
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Nick Canafax, President
River Ecosystem

Parker Thomas, FUSE Fellow
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Pietro Valsecchi,
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Greg Reichow, Partner
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Greg Theyel, Director
Biomedical Manufacturing Network

Hannah Kain, President and CEO
ALOM

Hanna Leen, MBA Student
Cal State East Bay

Henry Walaszczyk, Sr. Director, Global Quality Engineering
Lam Research

Henry Yin
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Ilan Gur, Founding Director
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Izzet Darendeli, Assistant Professor of Management
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Jason Singley
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Jeffrey Boman
IoT Consultant

Jens Vogel, President and CEO
BI Fremont, Inc.

Prashant Parekh, Founder and CEO
Spinta Global Accelerator

Prashant Shah,
Managing Director/Board Observer/Head
TiE Launchpad/PubNub/TiE Angels

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BASF

Rachel DiFranco, Sustainability Manager
City of Fremont

Rajan Kassetty, CTO Mentor
Cleantech Open

Ralph Mayer, Engineering Manager
Sanmina-SCI Corporation

Rana Gujral
VP/ EIR/ Mentor/ Advisor and Investor
Logitech/F50/Hack Temple/Start-ups Inc

Rick Jones, Vice Mayor
City of Fremont

Ritika Puri, Co-founder/Consultant/Mentor
Storyhackers

Robert Brakeman
Business Unit Director, Emerging Technologies
Jabil

Ron Sege, CEO and Founder
Echelon Corporation

Ruth Chao, Office Manager
Delta

Jeremy Theil, Principal and Founder
Mountain View Energy

Sameer Rashid, Co-Founder/Managing Partner
SuperCollider

Jim Tietz, CTO Mentor
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Scott Elrod, Associate Director
Stanford Office of Technology Licensing

Joel Falcone, COO
Excelitas Technologies

Scott Miller, CEO
Dragon Innovation

John J. Dutra, CEO
Dutra Enterprises Inc.

Shilpi Sharma, Fremont Chapter Director
Startup Grind

John Le, General Manager
Sanmina-SCI Corporation

Sophia Jin, Director, Venture Investment
Hanwha Q Cells

Jon Slavet, General Manager
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Congruent Ventures

Steve Hwang
VP, RMO/Fremont Research Center
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Karen Janowski, VP
Prospect Silicon Valley

Trina Ostrander, Executive Director of the Institute for STEM Education
Cal State East Bay

Katy Stanton, Program Director
Urban Manufacturing Alliance

Yuet Lee, National Mentor Program Chair
Cleantech Open

5.3 50 INNOVATION CULTIVATORS

500 Startups

AngelPad

Autodesk Pier 9

BioCube

Bolt

BootUp

BriteLab

CalCharge

Circuit Launch

CITRIS Foundry

Critosphere Cowork Space

Cyclotron Road/Activation Energy

Devlabs

Elemental Excelerator

Factory 510 at The Gate 510

Flextronics Innovation Labs

Founders Space

Gateway

Hanhai Investment Inc.

HAX Accelerator

Highway 1

ImpactHub

IndieBio

Kapor Center

Lemnos Labs

Matter

Oakland Start-up Network

Otherlab

Parisoma

Playground

Plug and Play Tech Center

Port Workspaces

Powerhouse

Prospect Silicon Valley

QB3

River Ecosystem

RocketSpace

Second Workspace

SFMade (Manufacturing Foundry at 150 Hooper)

Silicon Climate

SkyDeck

StartX

Sudo Room

TechShop

The Batchery

The Cleantech Open

The Foundry

Triple Ring Labs

WeWork

Y Combinator

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5.4 Innovation Cultivator Deep Dives: Profiles

The profiles below are based on the narrowed scope of the innovation center to advanced manufacturing with biotech and cleantech focuses. Of the 13 innovation cultivators analyzed, 10 were selected from the Bay Area and three were selected from across the country. Team LACI looked at programming, funding, facilities, business structures and other services provided.

CLEANTECH

Cyclotron Road

Established in 2015 at Lawrence Berkeley National Laboratory (LBNL), Cyclotron Road is focused on commercializing early stage hard science manufacturing and energy technologies. Its annual funding opportunity selects 10 companies for a two-year program. Each company receives a two-year fellowship that provides salary and access to engineers, scientists, and facilities at LBNL. Programming of Cyclotron Road includes entrepreneurship training, prototype development, and a variety of other activities. It has some limited office and conference room space, but what is unique to Cyclotron Road is that it is housed within LBNL. This special arrangement with the lab means its start-ups have access to billions of dollars' worth of world class facilities and equipment such as high-performance computers, nanotechnology labs, light sources, sequencing machines, wet labs, and numerous other unique facilities.

Powerhouse

Powerhouse was established in 2013 as a co-working space and seed fund that houses and invests in intelligent energy. Originally, they were only focused on solar energy. Most of its start-ups build software-enabled solutions for the clean energy industry. Powerhouse is both an incubator and an accelerator. Twice a year it runs a cohort-based six-month accelerator, which accepts companies of all stages. It provides typical entrepreneurship programming with an emphasis on networking and investor connections. The companies that are accepted into its accelerator are given free desk space, access to all office accommodations, and $10–50K in convertible note. While Powerhouse does not have labs or prototyping equipment, it does have co-working space, conference rooms, and event space for rent. Additionally, it is centrally located in downtown Oakland which is easily accessible by public transportation. Finally, Powerhouse is in the middle of revising its business model and will be establishing its own venture fund.

Prospect Silicon Valley

As a non-profit, city established organization, Prospect Silicon Valley (PSV) is an innovation hub focused on urban tech with an emphasis on clean energy, transportation, and grid technologies. It was established in 2013 and has a range of programs for start-ups as well as corporate and city sponsors. Companies receiving PSV's incubation services are given assistance with corporate partnerships, state and federal grants, and other entrepreneurship services. Its facility is equipped with co-working and conference room space as well as demonstration labs, which can be accessed for a fee. This includes a 23,000 square foot Technology Development Centre with shared equipment (milling machines, etc.), ITS Signal lab (connected vehicle technology), and a SimLab (driving simulation). PSV does not have a VC arm nor does it provide funding to start-ups incubated at its facility.

LIFE SCIENCE

The Foundry

The Foundry was started in 1998 and is a medical device incubator. It works with inventors as partners in providing staff and resources for the technical and commercial aspects of creating a company. The Foundry works with start-ups from their beginning phases up through financing and acquisition. When start-ups are selected for inclusion, team members from The Foundry become part of the "new company," filling technical and management positions and working with the inventor to guide the company to success. Thus, The Foundry and inventor become partners. The founder does not have to pay a fee to participate and The Foundry does not provide cash to the founder. The Foundry, like most VCs, will take equity in the company. It provides the typical incubation programming focused on early stage genius of a company and provides some prototyping assistance. The facilities include co-working hot desks and spaces for consultants and advisors. Additionally, the 10,000 square foot facility includes a wet lab, chemistry development facilities, equipped and machine shops, and a clean room.

IndieBio

Established in 2014, IndieBio is a biotech accelerator that provides seed funding to biotech entrepreneurs, mostly to advance commercialization of science. It runs two cohorts a year with around 15 start-ups in each cohort. Programming of IndieBio focuses on early stage entrepreneurship training like investor prep and business plan development. The facility includes conference rooms and co-working space, but is also co-located with HAX, a hardware accelerator with more than 14,000 square feet of space. This includes biotech labs with 20 BSL1 (biosafety level 1) and four BSL2 stations. They also have a large network of facilities that

lend equipment and expertise to the start-ups. Each start-up gets $200K in cash through the early stage VC accelerator SOSV. No additional fees for accessing space or equipment are required.

QB3

QB3, established in 2000, is the University of California's hub for innovation and entrepreneurship in the life sciences. Its five locations in the Bay Area combine a research institute with the elements of a start-up accelerator. While QB3 offers all the traditional programming of an accelerator, through its Start-up in a Box program, which has a fee, it is also connected to the Rosenman Institute, which aids entrepreneurs seeking to commercialize medtech or launch medtech start-ups. Rosenman start-ups rely on QB3 resources such as Start-up in a Box. The Rosenman Institute also supports its start-ups with pro bono mentoring from the Rosenman Fellows, which include 20 in the field experts, which bring years of experience in areas such as engineering, marketing, and regulatory matters. Additionally, QB3's five facilities include 40,000 square feet of space equipped with wet labs, offices, and conference space. Facilities include: -20˚C freezer, -80˚C freezer, autoclave, deionized water system, ice machine, fridge, incubator, HEPA filter, water jacket incubator, biosafety cabinets, flammable liquids cabinet, fume hoods, and compressed air lamp vacuums. Mission Bay Capital (MBC) was founded in 2009 to fund the development of technologies coming out of QB3.

MANUFACTURING

Bolt

Founded in 2013, Bolt is a venture capital firm designed to address the unique needs of early stage (pre-seed and pre-product) start-ups at the intersection of hardware and software. While Bolt is a VC, they act like an incubator providing entrepreneurial services as well as prototyping and design expertise. Its facilities include co-working, conference rooms, and event space. Additionally, Bolt's start-ups have access to Autodesk's Pier 9 prototyping facility, which includes a CNC, 3-D printer, wood, metal, textiles, and electronics shops as well as a test kitchen. As a VC, Bolt is nearly always the first institutional investor with initial checks up to $1M and average pre-seed checks of $200K.

Flex

Flex a full-service contract manufacturer specializing in electronics, established Lab IX in 2013, but shortly thereafter stopped its programming. Lab IX was supposed to help emerging technology start-ups, through investment and services. This included everything from sourcing

materials and scaling manufacturing to investment in the companies. Now Flex has multiple programs, centers, and platforms for start-ups to access these same facilities and services, but no set-aside investment fund for this activity. Additionally, the Lab IX facilities, originally located in Milpitas, now repurposed, had over $30M worth of equipment including 3-D metal and plastic printers, surface mount technology (SMT) lines, and capabilities in anodizing, advanced automation, microelectronics packaging and radio frequency (RF) technologies. Current programs still provide concept design, prototype creation, advanced engineering, intellectual property protection, new product introduction, additive manufacturing, global expansion, and supply chain, distribution, and logistics support. They can also do short-run production and assembly, like other contract manufacturers

Highway1

Founded in 2013, Highway1 is a hardware start-up accelerator. It is a division of PCH International, a consumer electronics manufacturing company. Highway1 is focused on getting hardware start-ups to the market through a semi-annual, cohort-based four-month accelerator that accepts 10 companies per cohort. Its programming focuses on incubation through growth with an emphasis on prototyping, design, manufacturing readiness, and supply chain assistance. Its facilities include co-working and conference space as well as 1,000 square feet of prototyping equipment such as CNC machines, laser cutters, and 3-D printers. Additionally, Highway1 provides on-site engineers and designers with access to local product development assistance from organizations like IDEO. One distinctive characteristic of Highway1 is its program takes start-ups to China for manufacturing assistance. Previously, accelerator activities were split between the United States and China. As of Jan 2018, the next two years of cohorts will solely be held in China. Start-ups that get into Highway1 receive VC funding from $50–100K.

Lemnos Labs

Established in 2011, Lemnos Labs is a VC that provides early stage hardware start-ups pre-seed and seed funding. Like Bolt, they also provide entrepreneurship training and have prototyping facilities. Assistance includes help with engineering, manufacturing, marketing, and accessing financial capital needed for hardware companies. Its facilities include 8,000 square feet of co-working, conference space, and demonstration/prototyping space, with a specific focus on robotics and machines. Lemnos is going on its third fund of $50M.

OUTSIDE OF BAY AREA

Greentown Labs (Manufacturing and Cleantech)

Founded in 2010, Greentown Labs is an incubator that runs two accelerator programs a year that focus on specific cleantech problems or corporate partner issues. This Massachusetts-based incubator with three locations, specializes in cleantech hardware in the United States and has incubated 110 companies. Greentown Labs provides typical entrepreneurship programming with an emphasis on prototyping and manufacturing readiness. It recently expanded into a new space which has extensive facilities including conference rooms, rentable event space, a full kitchen, co-working space, hot desks, and labs. The space is for start-ups, consultants, and corporate and community sponsors. Across its facilities it has wet labs, machine shops, electronics labs, equipment, and a variety of other prototyping spaces. Greentown Labs has a pay-for-use model for office and lab space. Prices vary depending on needs. It does not invest in companies nor does it have a VC arm.

NextEnergy (Manufacturing and Cleantech)

Established in 2002, NextEnergy is a Michigan-based accelerator focused on demonstrating and commercializing advanced energy and transportation technologies, with start-ups, businesses, and industries. Program activities depend on funding source, but generally they are a full-service organization providing everything from assistance with marketing and sales to prototype development and demonstration. They have significant rentable conference and event space as well as co-working areas and a common kitchen. This includes 10,000 square feet of leasable event space such as a 122-person auditorium, a 300-person auditorium, and a 60-person conference room. They also have 18,000 square feet of built-to-suit, leasable lab space. Additionally, unlike many other innovation cultivators, they have multiple platforms to demonstrate, test, and validate various advanced energy and transportation technologies including but not limited to distributed generation, demand response, energy efficiency, electric vehicle infrastructure, smart building, smart home, communications within commercial and residential energy applications, and EV bi-directional and wireless charging technologies. Depending on the source of funds for programming, start-ups or other organizations may have to pay to access these demonstration capabilities. NextEnergy does not have a VC arm and therefore does not take equity in companies for use of their equipment.

The Engine (Hardtech and scale up)

Founded in 2016 and based in Massachusetts, The Engine is an incubator focused on bring scientific discoveries in tough technologies into the world and commercialize them at scale. It

focuses on two vital stages in the life of a tough tech start-up: the early “proof of product” stage, when entrepreneurs begin to bring their discoveries to life, and the stage when they begin to scale up to commercial production. Originally spurred on by an MIT initiative, The Engine has strong academic ties and opportunities for programming while also offering more traditional services such as in-house experts and dedicated networking opportunities. Its facility consists of 25,000 square feet of makerspace, bio and chemistry labs, and co-working desks and offices. Unique to The Engine is its Engine Room, which is a network of tools and equipment in the area that can be used by The Engine companies, sometimes for a fee. Partners include: The Broad Institute, Lincoln Laboratory, Center for Nanoscale Systems, Microsystems Technology Laboratories, Computer Science and Artificial Intelligence Laboratory, and the Massachusetts Green High-Performance Computing Center. Additionally, The Engine has a Debut Fund of $200M long-term patient capital, $25M of which came from MIT. Cost to use the facility varies depending on how big the company is and whether it is in residence. All Engine Debt Funded companies have the option of using office/work space at The Engine at free or reduced rates.