Unraveling the Cultural and Social Dynamics of Regional Innovation Systems

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Executive Summary

America's research capabilities, entrepreneurial spirit and industrial prowess are poised to be focused and, in many cases, repurposed to realize the economic and employment returns many innovative technologies promise. However, if we are to be successful in assuring that all Americans share in this success, we need to expand the ability of many more locales to leverage their centers of basic research and related public and private R&D enterprises to enhance regional economic growth and competitiveness. Understanding what can accelerate more effective approaches to knowledge transfer, technology development and commercialization, as well as new S&T business start-ups is one way to accomplish this.

Our NSF-funded research, which focused on three cities in America - Philadelphia, St. Louis, and San Diego – each with high levels of research activity of potential value to growing science and technology based companies, provided some clues. We gathered significant data on regional characteristics, surveyed 215 technology companies and 89 innovation intermediary organizations, and conducted 126 in-person interviews. From this, we identified a variety of characteristics of innovation focused intermediary organizations and regional dynamics which may affect the levels of success cities have in identifying, qualifying, supporting and financing technology-based startup companies.

Our initial premise was that boundary spanning, by which we mean interdisciplinary and cross-functional, intermediary organizations are an essential component to the process of innovation. This is because entrepreneurial science and technology enterprises tap into multiple forms of knowledge beyond basic science to be successful. They also involve high levels of risk, constant attention, and recalibration on multiple fronts so that a new idea, technology, or process can find its way from the laboratory into the marketplace as a valuable product. As such, interdisciplinary, cross-functional organizations are critical to the knowledge flows, the expertise, and trust building which enable innovation and risk taking.

The study revealed several key findings. Among them are:

1. Intermediary organizations focused on supporting innovation are forming everywhere.
2. The nature of social interactions and types of knowledge flows within and among industry or technology-focused intermediary organizations vary by type of sector, e.g. software or pharmaceuticals.
3. The characteristics of these science and technology intermediary organizations are shaped by distinctive characteristics of "place". Place-based characteristics include such things as:
    - By whom and in what manner an organization is championed and created can influence its outcomes, i.e. "bottom up", grassroots efforts; created by a single champion; or government-inspired.

- The purpose and desired outcomes of an intermediary organization and its participants can vary depending on the knowledge, competency, and resource assets and gaps in a specific region.
- The value of intermediary organizations to entrepreneurs can be both direct and indirect. Direct benefits include such things as establishing links to investors, customers, or new talent. Indirect benefits can be such things as improving general contacts through networking, awareness of new technology or industry developments, and becoming more involved in the community.
- The motivations and competencies of coaches, mentors, and advisors who work with high tech entrepreneurs can vary from group to group and place to place. Further, the alignment of mentors' expertise and industry knowledge with the needs of high tech entrepreneurs often varies and may affect the value intermediary organizations deliver to their regional innovation ecosystem.

1.0 What We Set Out to Discover

The growth of new high technology industries and the corresponding creation of high-wage jobs are not evenly distributed throughout the United States. Regions with apparently similar characteristics and assets, such as large R&D institutions, global business know how, and access to capital for new ventures, vary in their rates of business and job creation. This study examined aspects of how the social dynamics and organizational practices of different regions may affect the localized economic returns on basic research activities. Current science policy and metrics capture many of the transactional activities that take place within a region, i.e. disclosures, patents, licenses, and venture capital deals among other indicators. However, these measures do not adequately capture the social dynamics that enable translational and business creation outcomes. Social organizations that facilitate knowledge flows, entrepreneurial alliances, and provide commercialization resources and support also play a role in affecting economic outcomes. Organizations which span institutional and hierarchical boundaries within a community, and serve as platforms that potentially accelerate the commercialization of new technologies, are being created across the country. Our research examined the character of the social dynamics and knowledge flows within a regional innovation system via these intermediary organizations, making comparisons among three regions – Philadelphia, St. Louis, and San Diego.

We defined a boundary spanning intermediary organization as a cross-functional group focused primarily on S&T innovation and commercialization that conducts activities on a regular (i.e. annually, quarterly, monthly, or weekly) basis. To be cross-functional, the organization needed to bring together a combination of two or more of the key participants in the innovation system such as researchers, business services providers, entrepreneurs, funding source decision makers (such as angel investors, venture capitalists, foundation executives and government officials), policy specialists, or real estate developers. These organizations also included other functional spheres such as sales and marketing, finance, accounting, applied research, design and engineering, or HR, either within a single industry or between multiple industries. Our assumption was that intermediaries facilitate critical network development by mobilizing previously unconnected people, which is important to the growth of high technology industries.

Philadelphia, St. Louis, and San Diego were selected based on a variety of factors. We chose a geographically representative sample which included a West Coast region, an East Coast region, and a region located in the Midwest. This was done to try and account for different regional economic histories, distinct social contexts, and the nuances of regional civic culture. We also wanted to examine regions with significant Federal science, engineering, and medical research portfolios (lending potential to technology commercialization), and well-established research universities and institutes, especially major medical schools, given the significance of NIH funding nationally. Further, though there is much research on the Silicon Valley and Boston, less is known about other innovative regions. Philadelphia, St. Louis, and San Diego provided an opportunity to look at potentially new and different dynamics that surround the regional innovation process.

2.0 How We Gathered Data

To examine the social and cultural dynamics of a regional innovation system, we employed a mix of data sources and methodologies, including web-based searches, mining public and private databases, site visits, and conducting interviews with key regional stakeholders in each of the three regions.

Intermediary organizations, our primary unit of analysis, were identified via structured web searches and from information gathered during the interviews to refine the list. Using our definition, we identified 128 organizations across the three regions, as shown in Table 1. Over two rounds of surveys, each organization was asked to provide information about its activities and services, number and frequency of events, participation rates, use of volunteers, and sources of financial support among other questions. We received 89 responses, or 69% overall, from the first survey. A second survey asking more detailed questions was sent to the 89 respondents. We received 58 responses, or 65% of the pool of 89 organizations, to the follow-up survey, which means our findings disproportionally represent the regions with higher response rates, namely San Diego and St. Louis.

Table 1: Number of Intermediary Organizations and Survey Responses by Region

	Philadelphia	St. Louis	San Diego	Total
Total # of BSOs Identified	56	26	46	128
# Respondents to 1st Survey	31	21	37	89
# Respondents to 2nd Survey	20	12	26	58

We also collected extensive quantitative information from a variety of public and private databases in order to characterize the innovation assets of each of the three regions, from which entrepreneurs could harvest potential applications and intermediaries could leverage for growth. Numerous public databases were used to gather statistics on items such as gross regional product, population, educational attainment, federal R&D funding, patents, and the R&D workforce. Data on startups and venture capital investments were obtained from private databases managed by Dun & Bradstreet and Thomson Reuters.

Dun & Bradstreet provided information on 74,748 companies formed between 2005 and 2009 across the three regions. Employing the definition developed by the Bureau of Labor Statistics and used by the National Science Foundation for high technology industries,[1] we narrowed the data set to 6,836 high technology companies. We then verified which companies were high tech and still in business as of 2012 using web searches and telephone calls in preparation for conducting an online survey to entrepreneurs. This survey was designed to gain a sense of whether intermediaries were used by entrepreneurs, what activities and services were valuable from their perspective, and to see how they characterized their region's capacity for innovation. The survey was sent to 596 companies in Philadelphia, 165 in St. Louis, and 375 in San Diego. Several organizations also forwarded the survey to

[1] See http://www.bls.gov/opub/mlr/2005/07/art6full.pdf. Based upon NAICS codes, this definition can be consistently applied across geographic regions, unlike many region-specific cluster definitions, and was selected on this basis and that it comes from a credible source.

companies they worked with. A total of 215 fully-completed surveys were received from 75 companies in Philadelphia, 70 in St. Louis, and 70 in San Diego.

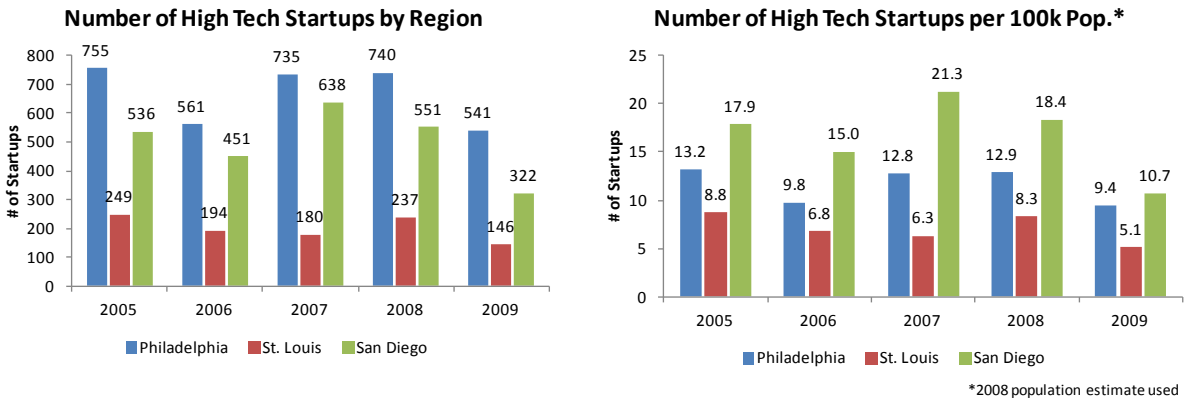
Additionally, the research team conducted two rounds of site visits to each region to interview key stakeholders, such as founders, funders, and staff of intermediary organizations; entrepreneurs; service providers; investors, and members of the research community. In total, 126 individuals were interviewed – 48 in Philadelphia, 51 in St. Louis, and 27 in San Diego.

3.0 Each Region is Unique

While there are some similarities between the three regions, there are also important differences. The Philadelphia innovation region encompasses a broader geography (5,118 square miles) extending into Delaware and New Jersey because of the traditional significance of the pharmaceutical industry in those states. The population of the Philadelphia region[2] is close to 6 million. The St. Louis region, which includes neighboring Illinois counties, actually covers more territory (8,458 square miles) than the other two regions, and has a population base of 2.8 million. The San Diego region, which is the entire San Diego County (4,200 square miles), has a population base of 3 million. Several charts illustrating some of the similarities and differences among the three regions follow. Additional data is included in the Appendix.

In absolute terms, the Philadelphia region sees more high tech companies formed on an annual basis, followed by San Diego and then St. Louis. When normed for population, however, San Diego emerges first, with Philadelphia coming next, followed by St. Louis.

Figure 1: High Tech Startup Formation, 2005-2009

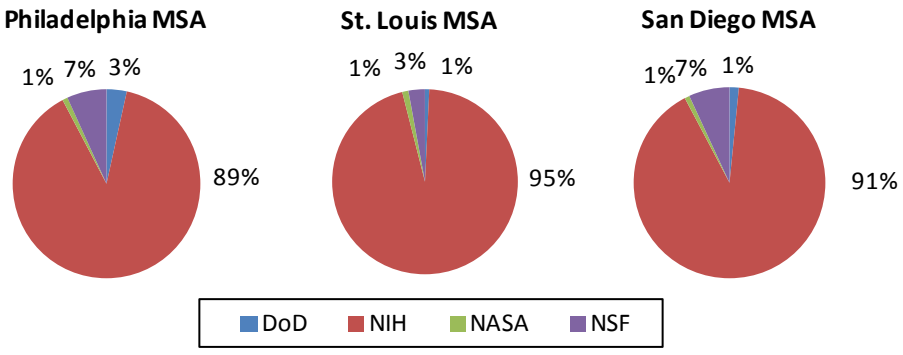


Source: Dun & Bradstreet

[2] Each region was defined geographically by US Census Bureau Metropolitan Statistical Areas (MSAs) boundaries. These boundaries largely align with how local citizens defined their region. The research team therefore used the MSA as the primary unit for collecting extant data on items such as research funding, patents, and business startups.

All three regions receive a significant amount of grant funding from US government agencies to conduct R&D. We looked at funding from four federal agencies, the Department of Defense (DoD), the National Institutes of Health (NIH), NASA, and the National Science Foundation (NSF), as these agencies have missions to support research that might translate into commercial products over time.[3] During a ten-year period, the Philadelphia region received $11 billion in R&D funding from these agencies, St. Louis received $5.6 billion, and San Diego received $11.4 billion. Figure 2 shows how this total breaks down within each region as a percentage by agency. NIH is clearly the dominant source of funding. Additional charts in the Appendix provide more detail on the amount of funding by agency for each year, and norm the data for population. When normed for population, San Diego brings in more funding from NIH and NSF, and is roughly equivalent to Philadelphia for DoD funding since 2006. The three regions have received approximately the same amount of funding from NASA since 2005 when viewed on a normed basis. From the four federal agencies combined, R&D grant funding per 100,000 people over the ten-year period is $189,106,745 for Philadelphia, $202,087,242 for St. Louis, and $386,476,676 for San Diego.

Figure 2: Percentage of Regional Federal R&D Funding by Agency, 2000-2010

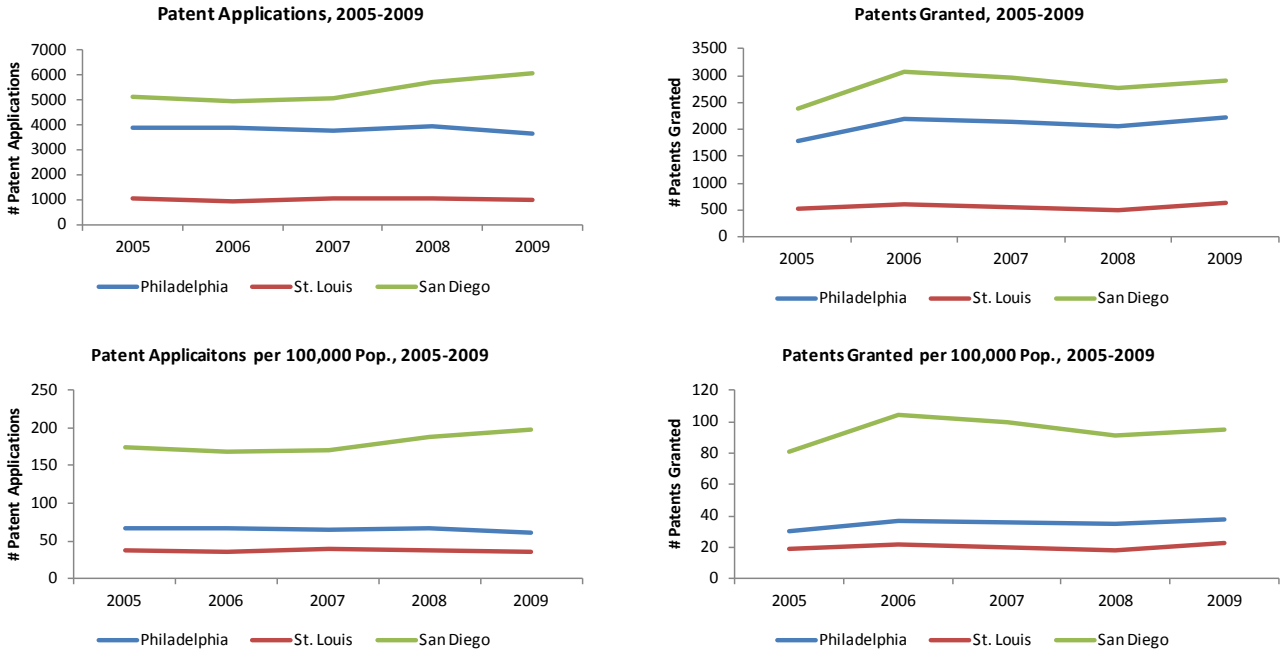


Sources: USAspending.gov, National Institutes of Health

The number of patent applications and patents granted are often used as one measure of regional innovation capacity. However, it is widely understood that these are not perfect metrics. Not all inventions are patented, and not all patented technologies become commercialized. Nonetheless, we included it here. As seen in Figure 3, San Diego produces the highest number of patent applications and patents granted in absolute terms, followed by Philadelphia and then St. Louis. When normed for population, a notable gap appears between San Diego, and the other two regions. The number of patent applications per 100,000 population averaged over the five-year period of 2005-2009 are 65.01 for Philadelphia, 37.1 for St. Louis, and 180.04 for San Diego. The five-year average for the number of patents granted per 100,000 people is 35.17 for Philadelphia, 20.05 for St. Louis, and 94.21 for San Diego.

[3] Other agencies, notably the Department of Energy, were not included due to challenges in the way the data is collected and reported.

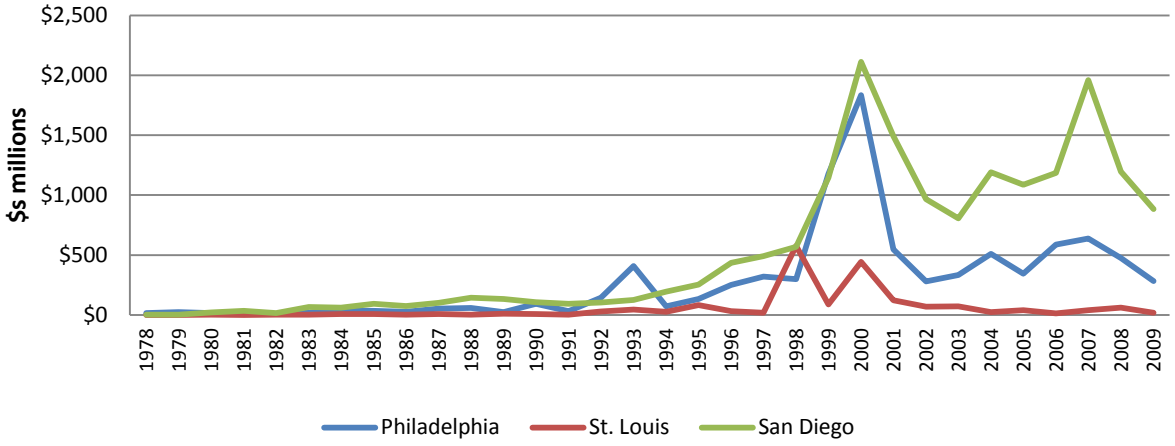
Figure 3: Patent Applications and Patents Granted, 2005-2009



Source: US Patent & Trademark Office

The amount of venture capital (VC) invested in technology companies is an oft-used metric for how innovative a region is. While not a perfect metric, given that not all technology companies seek VC funding, or necessarily make for good investment opportunities from a VC perspective, this indicator does provide a sense of activity in a region's technology sectors. VC funding is also used to help move a product to market or allow a company to scale, which are important parts of the innovation process. The figure below shows how the three regions compare in terms of VC funding, going back to the late 1970s. As can be seen, the regions were essentially equal until 1999, just before the peak of the dot com boom, and then clearly differentiate after the tech bust in 2001.

Figure 4: Venture Capital Funding, 1978-2009



Source: Thomson Reuters VentureXpert

Industrial Legacies

Examining venture capital funding raises significant questions about why, with parallel R&D assets, the regions vary in willingness to invest locally or attract external forms of investment in new ventures. Combined with the variation in rates of patenting, the data demonstrate that multiple factors influence the rate at which innovation and entrepreneurship overall take hold in a region.

The historical traditions and behavioral norms of each region may relate to the contemporary challenges, and specific strategies for innovation in each place. Our findings point to distinctive differences in historical legacies which over time may have shaped the social behaviors characterizing the respective regional innovation systems.

Philadelphia, one of the country's oldest metropolitan regions on the eastern seaboard, has an economy built upon a long history of traditional manufacturing, which declined after the Second World War as other emerging sectors created a more diversified base. The pharmaceutical industry in the region also has roots that go back at least to the early 19th Century, and it has a powerful legacy as the headquarters location for many global pharmaceutical companies. Additionally, Philadelphia is home to a large number of universities and healthcare institutes. Despite a diversified economy, many interviewees described the innovation community as fragmented. New innovation strategies and organizational platforms are being developed, but they are not overlapping and are geographically dispersed from a participant perspective. The community appears to be well-networked, but primarily within occupational and industry sector "silos".

St. Louis is located in the heart of the Midwest and has been a major center of commerce, agriculture, and industry since the latter half of the 19th Century and early 20th Century. Its fortunes have waned since the end of the Second World War, but it is still home to several significant Fortune 500 companies, including Monsanto. St. Louis also has an asset in the form of considerable inter-generational family wealth that has been used to support numerous philanthropic initiatives. The prevailing regional culture appears to be insular and hierarchical, with many initiatives, particularly in the life sciences and IT sectors, being driven by a few key individuals. St. Louis is adopting an innovation agenda to improve its regional economy, but until recently had been layering these efforts on top of existing social and business networks such as the important St. Louis Regional Chamber and Growth Association.

San Diego is a West Coast city historically known as a "navy town" with a large number of military installations and large defense contracting industry, as well as a popular vacation destination for tourists. Unlike Philadelphia and St. Louis, San Diego does not have a significant history of strong commercial and industrial manufacturing, or agricultural sectors. Highly dependent on the federal government's military installations and investments, it has been essentially a "small business" town for more than a century, creating local fortunes only recently. Building upon a research capacity that was linked to technology development during World War II, the region is now home to world-class technology clusters such as biotechnology and wireless communications. With a weak pre-existing industrial and civic establishment to accommodate, it grew its innovation system as a result of collective

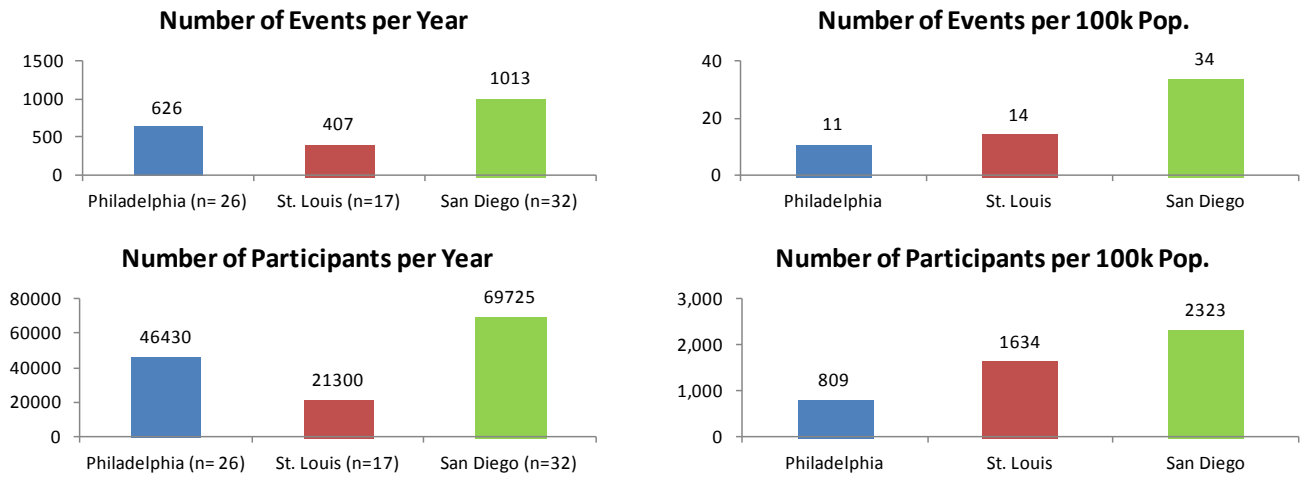
efforts of small business leaders. While socially inclusive and open in terms of information sharing, its culture has often been characterized as naïve and occasionally bordering on boosterism.

4.0 What We Learned About Intermediary Organizations

While the three regions studied contained multiple intermediary organizations, the research team discovered that the organizations within each region varied in terms of the level of participation, the social networks they enabled, the types and frequency of programming offered, and the talent they utilized, which all led to varying types of perceived benefits to entrepreneurs.

Data collected on the intermediary organizations included the annual number of events, approximate annual number of participants, and diversity and frequency of participation. As shown in Figure 5, organizations in San Diego collectively had the highest number of events and number of participants, both in absolute terms and when normed for population. Interestingly, intermediaries in Philadelphia have the second highest rates in absolute terms, but fall behind St. Louis when normed for population. Within each region, the annual number of events and participation tended to be more highly concentrated in one or two organizations. Additional data is presented in the Appendix.

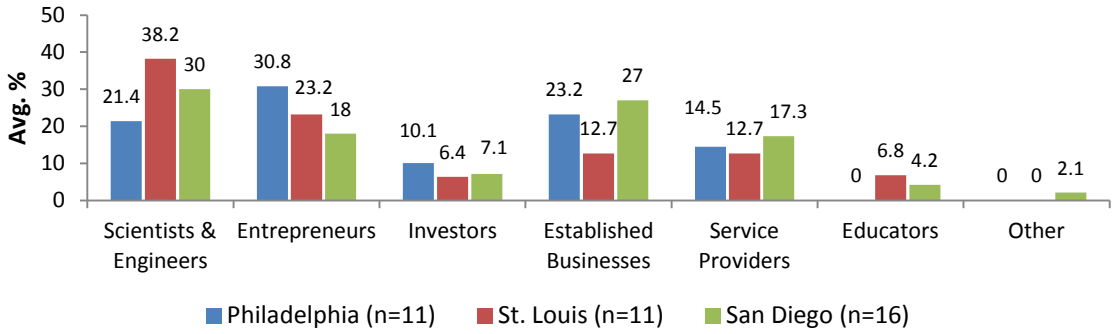
Figure 5: Annual Number of Events and Participants



The characteristics of people who participate in the networks created by these intermediaries can influence the types of knowledge and relationships are shared. Who is in the network, what they are able to contribute, and structure of the network matter. Networks are enabling only if the knowledge and relationships they generate are relevant to the companies or people they serve, which in the case of this study are technology startups. Beyond total numbers of participation, the diversity of participants in intermediary organizations across the regions is shown in Figure 6. As reported by organizations, the average percentage of scientists and engineers participating in activities and events in St. Louis

exceeded those in Philadelphia and San Diego, while more entrepreneurs were reported to attend functions in Philadelphia.

Figure 6: Participant Affiliation - Average Percentage by Type



How Intermediary Organizations are Created and Funded

Regions differed in how intermediary organizations were funded and by whom. Some were created by grassroots efforts, with a group of individuals coming together around a shared vision. Some organizations were driven by a single champion in the community, around whom others coalesced in pursuit of a particular mission. Examples include CONNECT in San Diego (grassroots driven) and the Coalition for Plant and Life Sciences in St. Louis (champion driven). Organizations created by diverse, grassroots coalitions tended to have significant buy-in from their community constituents, but also were apt to have more complex governance and financial structures. In contrast, those organizations that had a single or a few champions were less likely to need a broad financial base, and maintained a more narrowly focused mission as they delivered their programs and activities. Additionally, members of the community tended to defer many key decisions to the primary champions or funders.

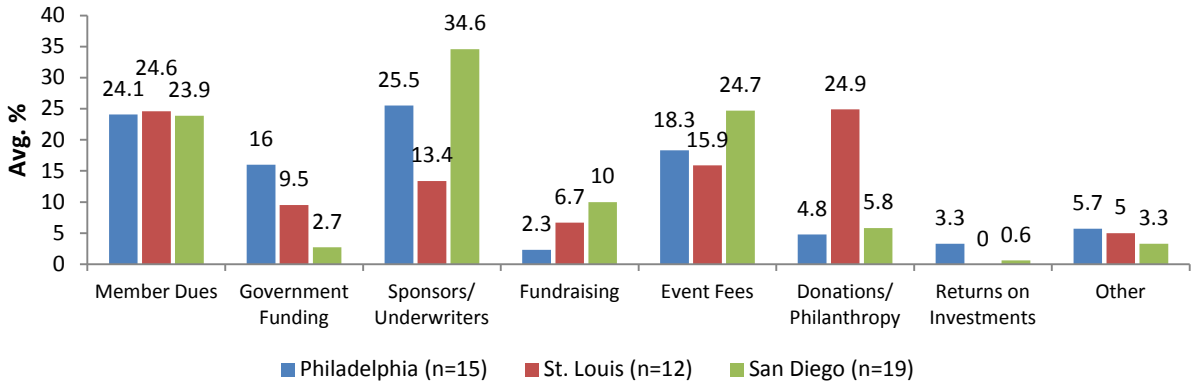
Intermediary organizations may also be established as a result of government policy, primarily to achieve economic development goals such as increased jobs, promote higher wages, as well as business attraction and retention. The most prominent example of this type is the Ben Franklin Technology Partners in Pennsylvania, created and entirely funded by the State. Within the Philadelphia region, the local Ben Franklin office played a critical role in providing early stage financing to startup technology companies. However, the organization, now subject to dwindling government budgets, has been forced to become more selective in how it allocates and distributes its financing.

Lastly, the team observed a process of "churn" in the formation and chronology of intermediaries. Specifically, many of the more recently created organizations in a region were established as a result of needs not being met by already established organizations. Founders of new organizations often stated that they were filling a niche that came about due to shifting industry needs, new technologies, and even generational shifts among entrepreneurs. Several organizations came about when the founders felt that activities and programs offered by existing groups did not fit with their particular needs. Another motivating factor included the emergence of new organizations in response to new

technologies and markets. Mobile Monday Mid-Atlantic in Philadelphia and the Wireless Life Sciences Alliance in San Diego were two examples of this phenomenon. Lastly, intermediaries have been created to fill both geographic and generational needs. Capital Innovators in St. Louis was formed to help reinvigorate a decaying downtown by placing young tech entrepreneurs in an incubator facility. The EvoNexus accelerator in San Diego has a somewhat similar objective of bringing tech talent to the downtown area, as does the IndyHall shared workspace in Philadelphia. Each organization recognized the importance to its mission of attracting and retaining talent, particularly recent college graduates who have founded IT, mobile, or consumer internet companies.

Related to the rationale for why intermediaries were founded and how they are organized, survey data on how these groups are financed reinforced the key differentiation between the three regions. As shown in Figure 7, among responding organizations, those in Philadelphia reported more government support, while San Diego respondents reported receiving approximately one third of their funding from private sponsors and underwriters. St. Louis organizations reported nearly one quarter of funding coming from philanthropic sources.

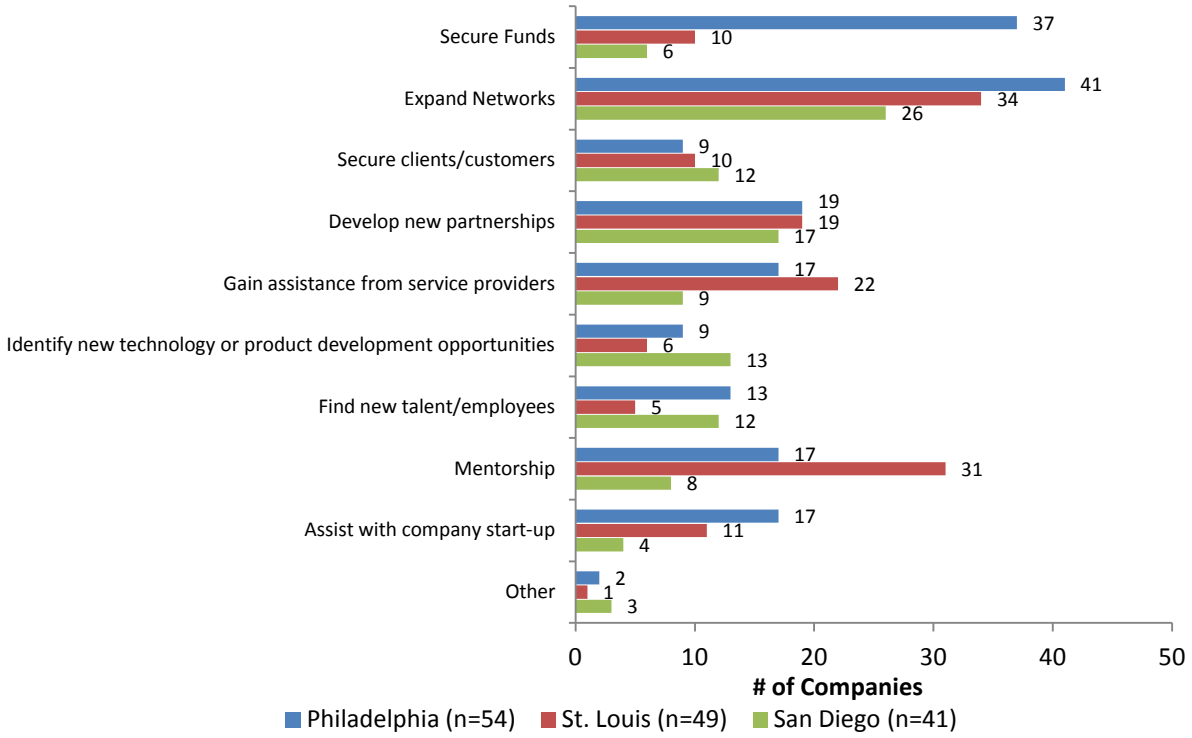
Figure 7: Organization Funding, Average Percentage by Source



Benefits of Participation in Intermediary Organizations

The perceived benefits of participation in events and programs by entrepreneurs, the way in which mentorship matters, and the ability of intermediaries to provide the platforms for expanding personal and professional networks also vary by place. Overall, entrepreneurs who engaged with intermediaries found them to generally be valuable. The figure below summarizes the benefits reported.

Figure 8: Valuable Types of Intermediary Organization Assistance to Entrepreneurs



In follow-on interviews, entrepreneurs stated that their participation provided a wide range of benefits, both direct and indirect. Different organizations provide value for different things. As shown above, entrepreneurs may gain direct benefits for their business, such as new financing, new customers, and critical new employees. Additionally, these entrepreneurs turn to intermediary organizations to expand their networks, receive assistance in the form of mentorship and business strategy, and indentify service providers who can assist on particular issues like legal counsel. In Philadelphia, the number of entrepreneurs who secured funds through these organizations was significantly higher than in the other two regions. This is largely due to the presence of the state-funded Ben Franklin Technology Partners, which provides early stage financing. In St. Louis, mentorship scored highly, with many survey respondents having participated in the Innovate Venture Mentoring Service program.

Entrepreneurs also stated various indirect benefits from participation, which included increasing general awareness of the industry and market, new technology developments, and gaining a sense of who potential future partners and/or competitors might be. Some entrepreneurs described attending activities without any defined purpose or expectation, but believed their participation allowed them to stay active in the industry and community. Entrepreneurs also expressed a commitment to place and improving the community as a whole through their participation. The importance of mentors and networking merit additional discussion.

Mentorship of High Tech Entrepreneurs

To many entrepreneurs, mentors can create a pivotal and important pathway to navigating the complicated terrain of starting a successful technology company. Several intermediary organizations we encountered provide hands-on coaching and mentoring programs to fill this need. Mentors offer the ability to leverage specific networks and resources at different stages as needed on behalf of the mentee, as well as provide critical input on business strategy. We found that there were different motivations for why individuals served as mentors, which in turn affected the perceived benefits to entrepreneurs. A majority of mentors participated in order to give back to the community. However, in some instances, entrepreneurs felt that a few mentors had more self-interested objectives, such as "just looking for the next deal or to jump on as CEO". In such instances, entrepreneurs expressed concerns that self-interested motivations undermined both the credibility of the advice being provided as well as the trust between mentor and mentee.

While most entrepreneurs indicated that they benefited from mentorship, there were notable differences within and between the regions. In Philadelphia, the fact that Ben Franklin Technology Partners is able to support and pay its mentors for advising entrepreneurs significantly affects who participates as a mentor. In interviews, both mentors and entrepreneurs stated that the ability of Ben Franklin to provide compensation encouraged at times a more professional and knowledgeable mentorship pool than other intermediaries. Further, interviewees said that Philadelphia's diverse economy enabled those organizations with mentorship programs to align mentorship expertise with the needs of the entrepreneurs seeking advice. As one respondent said, "Philadelphia is not known for just one thing. There is a breadth of what we are doing, which is based on our past, which helps lead us to our future. It is a virtuous entrepreneurship cycle that connects the right mentor to mentees."

In contrast, St. Louis's mentor pool tended to be comprised of older, retired business people who had experience working in large companies. These mentors were often motivated to volunteer their time as a means to give back to the community, and were rarely, if ever, paid for services. Although entrepreneurs frequently praised mentors for the dedication and willingness to share their knowledge, many of the budding entrepreneurs felt that the mentors' knowledge did not align with their particular needs as a startup company (which differs from a large, established company), as well as the specific technology the company was developing. The following quote from an entrepreneur in St. Louis captures this dynamic:

> "I run a Web 2.0 business and I am working with [a mentor] who set up a large manufacturing business. He is a very nice guy and means well, but he doesn't understand how radically different the business model and structure of a Web 2.0 business is from his manufacturing business."

Intermediary organizations we interviewed in St. Louis are aware of this challenge, and are seeking to add new capabilities and improve on practice to enhance successful outcomes.

Within San Diego, the well-developed technology industries provide a deep and knowledgeable pool of experienced entrepreneurs and businesspeople who serve as mentors. Over time, a culture of mentorship and giving back without compensation has led to the growth of a large number of volunteer mentors. That said, motivations for participation as a mentor still varied. A large number do so as a means to support the community and help the next generation, others did it to stay active in their industry. Overall, San Diego entrepreneurs expressed satisfaction with the mentorship programs offered by organizations in the region. Occasionally, some entrepreneurs expressed concerns as to whether their mentors were motivated by more self-interested reasons. The organizations that oversee mentoring programs are adopting processes to vet, evaluate, and monitor the quality of their mentors to address this issue.

Networking

Expanding networks was the most frequently stated benefit of participation in intermediary organization events in all three regions. This took the form of both general networking, in which the entrepreneur does not have specific expectations about whom they will network with in advance, as well as purposeful networking with specific goals in mind. For many, they just needed a platform from which they can begin to build relationships and networks, which may prove valuable to their business in the future.

> "The benefits of my involvement are often indirect, but important. Through networking, you find out if a large incumbent firm is bidding on a contract. If they are, then they are likely to win. So it helps you make a decision about whether you want to bid or not, how to allocate your time and resources. Again, the benefit of being in these groups isn't direct…but it does help you stay informed." – San Diego entrepreneur

> "[T]o be a practitioner, you have to be visible and embedded in the system you operate in. You need to be seen as a player in the tech space. So these activities allow me to get to know what's going on. It's also good for networking. I meet entrepreneurs, VCs, and other lawyers at these events." – Philadelphia service provider

> "Regarding networking, you have to plant many seeds. There are so many networking events with diverse people. You need to find your niche, and get out of it what you need." – St. Louis entrepreneur

Social Networks and Barriers to Innovation

Research has documented the significance of networks to the innovation process. Networks may be open or closed in terms of participation and how knowledge flows. The degree of openness is dependent on several factors, such as the presence of social hierarchies, whether network membership is static or dynamic, and markers of legitimacy and credibility for members among others.

Along these dimensions there were qualitative differences in the broader social networks within the three regions studied, as manifested in many of the intermediary organizations. These fell across an

open-closed continuum based upon the three characteristics described above. Within St. Louis, numerous interviews identified "blue bloods", which referred to an old boy network of wealthy, established individuals who had clout and were at the top of the social hierarchy. Interviewees expressed concern about the ability of outsiders and "those who didn't attend the right high school" to break into the old boy network. Most interviewees were born in the region and decided to stay. It was rare to find individuals who had moved to St. Louis from elsewhere. This cultural dynamic created a more closed society which presents a challenge to those with non-conforming ideas or insufficient social capital (i.e. connections and knowledge of insider social traits) to become integrated into the existing social network. Anecdotally, for those outside of the network, it becomes more difficult to gain the trust of well-placed individuals who can in turn provide critical access to resources valuable to startup companies. However, for those who have been brought into this network, they noted that trust was readily bestowed and it was relatively easy to access resources. Another characteristic of St. Louis's old boy network was its small size. Key individuals are well known, and therefore the network is able to mobilize quickly. A challenge to this is that the network potentially leaves out others who could contribute, but are not given the opportunity due to their "outsider" status.

In contrast and at the other end of the comparative spectrum, rigid social hierarchies did not appear to play a role in San Diego's innovation ecosystem. This may be due to the region's younger history of development as well as the transient nature of its citizenry. Many of the entrepreneurs interviewed for this study moved to San Diego from other locations. As such, history and tradition do not pose significant barriers to accessing resources and social networks vital to entrepreneurs. According to interviewees, cliques do exist, but they were more associated with industry sectors such as defense or life sciences, rather than social hierarchy. The cliques also were not perceived to be difficult to navigate.

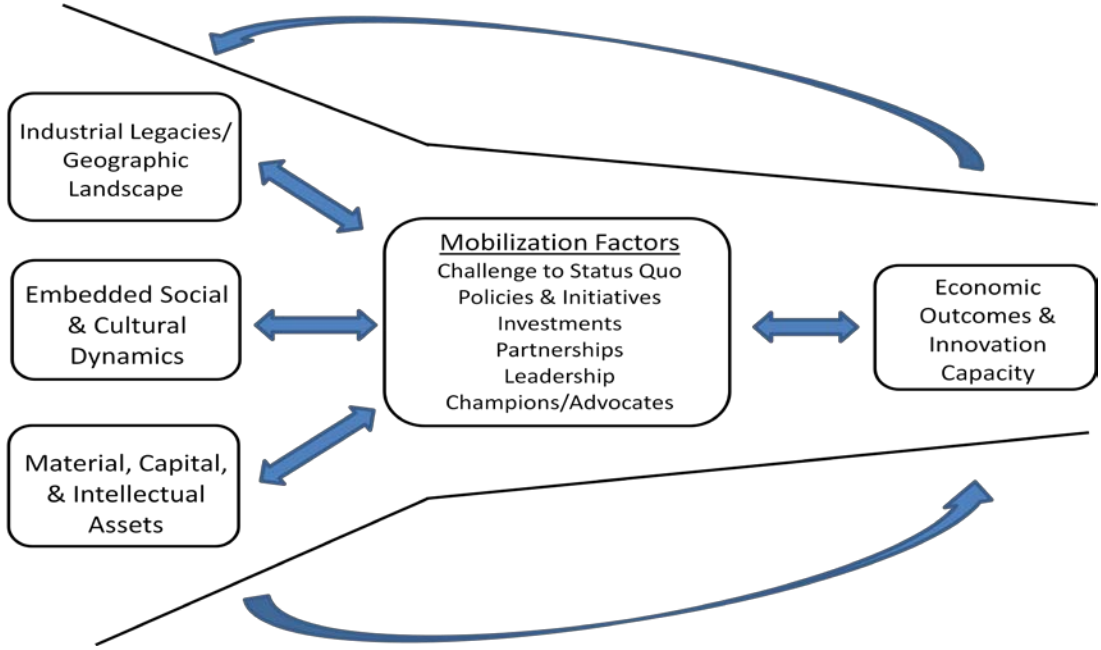
Somewhere between the more closed system of St. Louis and a comparatively open one in San Diego, is Philadelphia. Interviewees frequently noted the presence of "old money" and the region's long history. Yet, perhaps because of the many universities and proximity to other major population centers such as New York and Washington, DC, there are aspects of the social system that appear to have a degree of openness due to people moving in and out of the region. As a result, Philadelphia has an interesting mix of both the old boy networks and cliques, which some felt made it difficult to get resources, as well as the open social structures seen in San Diego's technology community.

5.0 What Our Findings Mean

The rich data that emerged from both the quantitative and qualitative methodologies incorporated in this multi-year study revealed a dynamic interaction between three factors which suggest a theoretical model emerging from the research. This model going forward could inform research and hypothesis building in a meaningful way. Industrial legacies, technological histories, and geographic landscapes are all contextual factors which affect innovation capacity, as are the material, capital and talent assets of a region. How these legacies and assets become leveraged are shaped by distinctive embedded social and

cultural dynamics and the spirit and character of a community - based in part on the traditions and practices which earlier industries and populations brought to the region. Together, these are mediated by a region's organizational capacity to mobilize for change. Mobilization factors are such things as civic practices, existing social organizations and leadership groups through which a community learns about, interprets, and eventually mobilizes around new economic challenges and opportunities. The outcomes of this mobilization, such as the growth of new industries and establishment of new institutions, can in turn affect the regions social and cultural dynamics, assets, etc., thus allowing for a region to alter its economic trajectory over time. How people perceive the value of their regional assets and how they choose to leverage those assets are often shaped by these deeper and somewhat under-studied cultural and organizational forces. The figure below provides a framework for understanding for how social dynamics affect social outcomes.

Figure 9: Framework for Understanding How Social Dynamics Affect Economic Outcomes



This comparative study of Philadelphia, St. Louis, and San Diego provided insights into social dynamics potentially useful to future research on regional innovation capacity. The intermediary boundary-spanning organizations (i.e. the networking groups, trade associations, and entrepreneur support organizations among others) in all three cities have important similarities and differences. Although, roughly equivalent in number and in some cases, amount of activity delivered, these organizations provide very different kinds of expertise, know-how and connections to resources. This appears to have been influenced by the characteristics of the legacy industries in each of the regions, and the social and cultural dynamics which have been shaped by the core economic activities and key demographic characteristics of the people who migrated to each region.

All three regions are genuinely committed to developing their innovation capacity and building high value added science and technology clusters, and adding high wage jobs. They clearly recognize the value of intermediaries and networks in that process. However, how intermediaries are formed, what content and resources they deliver, and who they engage can vary widely. Thus, what we observe are three regions on similar journeys, but at a different pace and with different kinds of enablers. Even within a region, industrial sectors experience their own development paths, which must be taken into account when developing strategies to enhance regional competitiveness.

Following three communities over a four-year period has led us to venture a few preliminary insights about what kinds of organizational practices and social dynamics accelerate innovation. For one thing, it is absolutely clear that community dynamics are just that - dynamic. They change, they evolve over time. Organizations grow, organizations close down, organizations merge and organizations adapt as new challenges and opportunities confront them. We were quite impressed with the growth and diversification of intermediary organizations within all three of the regions we studied. We were also impressed with the serious way in which the research universities, the private research institutes and civic leaders were constantly integrating new ideas and new practices as they grappled with how to be more active partners in, or accelerators of, the innovation process.

Given this characteristic of the innovation focused organizations we observed, not only in the cities that we studied with NSF support, but in other projects in which the research team at UC San Diego has been involved in, such as upstate New York, Central Michigan, Indiana, and regions across the West, we would like to suggest a few questions that any community might consider as they reflect on where they have been, where they are and where they want or need to go.

In our view, every community needs to address on an ongoing basis what the attributes of its local economy and local context are, and what about those attributes is enabling or inhibiting of change and forward movement. To this end we think there are four questions that should be routinely examined at the level of the broader community:

1) What are our industrial legacies and how are they enabling, or inhibiting us on our journey towards new, more innovative economic outcomes?

2) What are the culture and priorities of our research universities and institutes, and what impact does that have on how capable we are of achieving innovation outcomes?

3) What is the character of our business culture, our management capabilities, our legal and financial institutions, and our land and real estate communities: Are they poised to be enablers or do they engage in practices which may slow down the innovation dynamics required for today's globally competitive sectors?

4) How inclusive is our community? In particular, vis–à–vis participation in and leadership of organizations focused on innovation and entrepreneurship: Is ours a civic culture which can rapidly integrate young people and newcomers, or are we more inclined to rely on established practices and leadership? Is that helping or hindering us?

Additionally, intermediary organizations, or what we called in our research, boundary spanning organizations, need to be engaged in a continuous process of assessing where they have been, what they are doing today and what they need to do moving forward in order to provide the resources essential to growing innovative sectors. Intermediaries may wish to address the following kinds of questions on a regular basis:

1) Is our organization, leadership, and financing structure maximizing the knowledge flows, trust building, and shared investment needed to assure the innovation outputs we are seeking, or is it standing in the way of our success?

2) Are we absolutely clear about what we are trying to accomplish? Who we are trying to help and, are our educational programs, technical assistance activities, mentoring and coaching strategies aligned with the goals we are trying to meet as well as the needs of the people we are trying to support?

3) Have we identified metrics of success, and are we regularly gathering data, including surveys of the people we assist, so that we have consensus early on, and are able to make mid-course corrections based on regularly assessing our outcomes? Are we using new technologies effectively in order to gather this kind of information?

In an innovation environment things are always changing, always uncertain, and typically opportunity-rich. On the other hand, what may be an asset today could be a liability tomorrow particularly vis–à–vis the civic culture and larger community dynamics in which innovation is being supported. Every community has to deal with new and unexpected external imperatives – a financial crisis, a major shift in global markets, a game changing technology. That is why nimbleness becomes so important. How nimble a community can be, as well as how nimble the intermediary organizations seeking to assure economic prosperity in that community can be, depends on how readily and rapidly the community can engage new realities, integrate them into everyday practice, and build and retain the talent needed. The questions just posed, in our view, are a step towards helping every region across America unravel the cultural and social dynamics of their regional innovation systems. In this manner, they can be put to positive purposes rather than inadvertently undermine aspirations and expectations.

Appendix

TableA-1: Regional Population, 2001-2010

Year	Philadelphia MSA	St. Louis MSA	San Diego MSA	U.S.
2001	5,693,275	2,701,634	2,824,987	277,017,622
2002	5,722,541	2,719,279	2,867,094	280,540,330
2003	5,755,874	2,733,818	2,901,235	282,909,885
2004	5,822,876	2,743,862	2,926,814	285,691,501
2005	5,850,621	2,759,153	2,935,672	288,378,137
2006	5,880,912	2,773,155	2,941,770	299,398,485
2007	5,912,678	2,791,682	2,947,222	301,621,159
2008	5,940,496	2,806,368	2,975,656	304,059,728
2009	5,968,252	2,825,769	3,053,793	307,006,550
2010	5,965,343	2,812,896	3,095,313	308,745,538

Source: US Census Bureau

Table A-2: Gross Regional Product Per Capita, 2001-2010

Year	Philadelphia MSA	St. Louis MSA	San Diego MSA	U.S.
2001	$45,385.19	$38,714.12	$41,352.11	$35,680.66
2002	$47,410.25	$40,246.63	$43,779.00	$36,422.64
2003	$49,936.90	$42,095.53	$46,296.71	$37,370.16
2004	$52,178.03	$42,918.57	$49,959.50	$38,740.25
2005	$50,954.90	$42,742.99	$53,667.53	$40,880.04
2006	$51,741.98	$42,594.31	$54,331.29	$41,932.54
2007	$51,032.81	$44,294.61	$55,931.05	$44,131.31
2008	$52,047.57	$45,901.13	$57,037.62	$45,942.88
2009	$56,237.24	$44,691.20	$55,333.15	$46,480.55
2010	$58,157.93	$46,121.15	$55,428.32	$45,434.37

Source: US Bureau of Economic Analysis

Table A-3: Regional Area

Region	Area (sq. miles)
Philadelphia MSA	5,118
St. Louis MSA	8,458
San Diego MSA	4,200

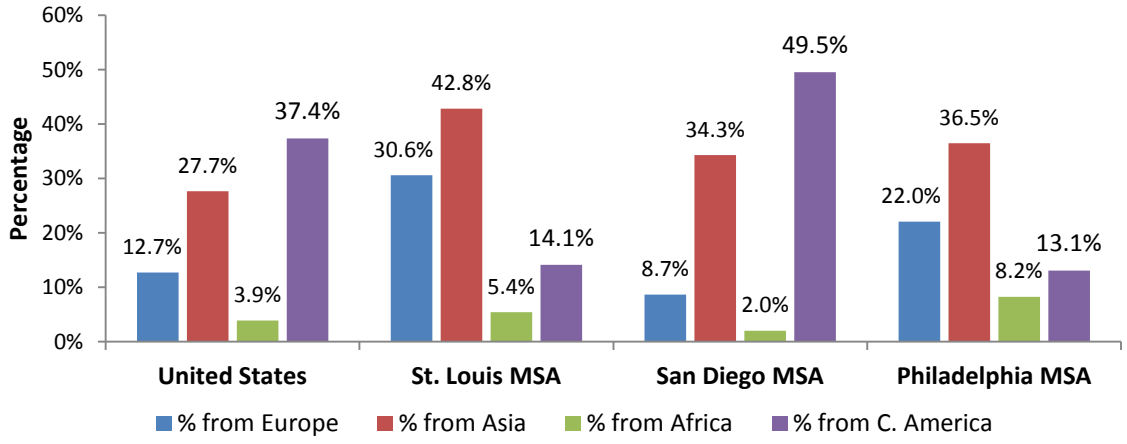
Source: US Census Bureau

Table A-4: Citizenship Status of Population, 2010

	U.S.		Philadelphia MSA		St. Louis MSA		San Diego MSA	
	Number	%	Number	%	Number	%	Number	%
Native Born	269,393,835	87.08%	5,402,019	90.46%	2,688,655	95.51%	2,377,605	76.55%
Naturalized citizens	17,476,082	5.65%	288,993	4.84%	59,659	2.12%	333,023	10.72%
Non-citizens	22,479,772	7.27%	280,471	4.70%	66,854	2.37%	395,361	12.73%

Source: US Census Bureau

Figure A-1: Place of Birth for Foreign-Born Population, 2009



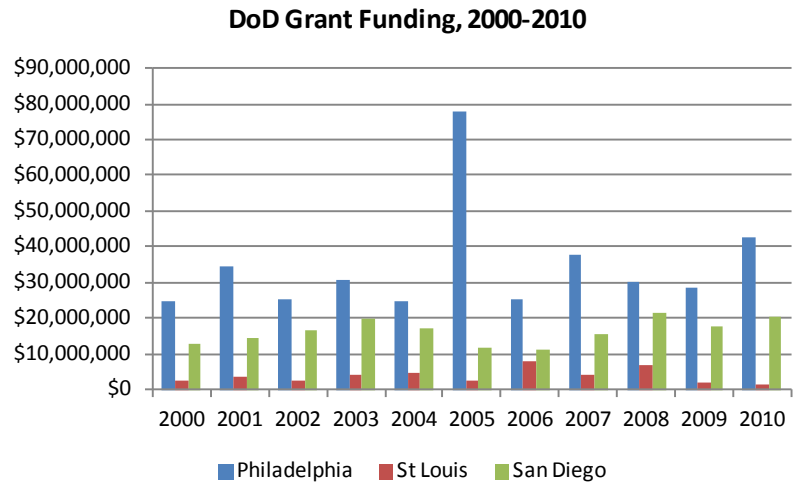
Source: US Census Bureau

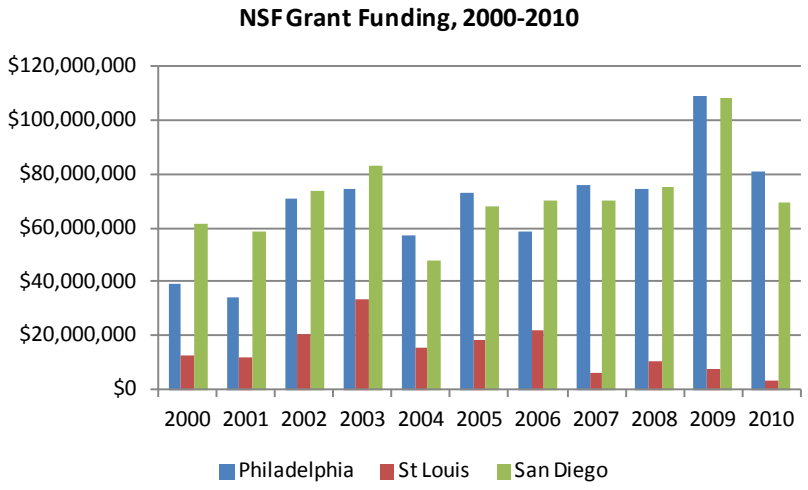
TableA-5: Educational Attainment of Population Aged 25 Years and Older, 2010

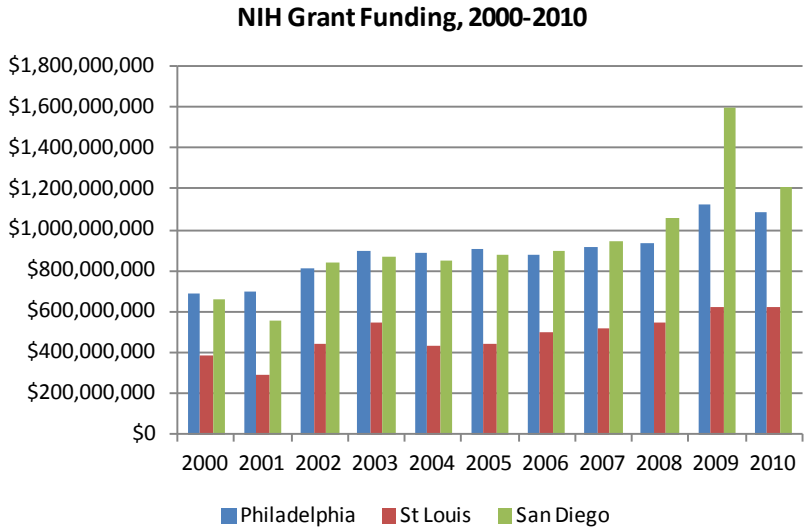
	U.S.		Philadelphia MSA		St. Louis MSA		San Diego MSA	
	Number	%	Number	%	Number	%	Number	%
Bachelor's degree	36,244,474	17.70%	799,134	20.10%	347,530	18.40%	423,183	21.00%
Graduate or Professional degree	21,333,568	10.40%	519,992	13.10%	217,027	11.50%	255,173	12.70%
% of Pop with BA or higher		28.20%		33.10%		29.90%		33.70%

Source: US Census Bureau

Figure A-2: Federal R&D Grant Funding, 2000-2010







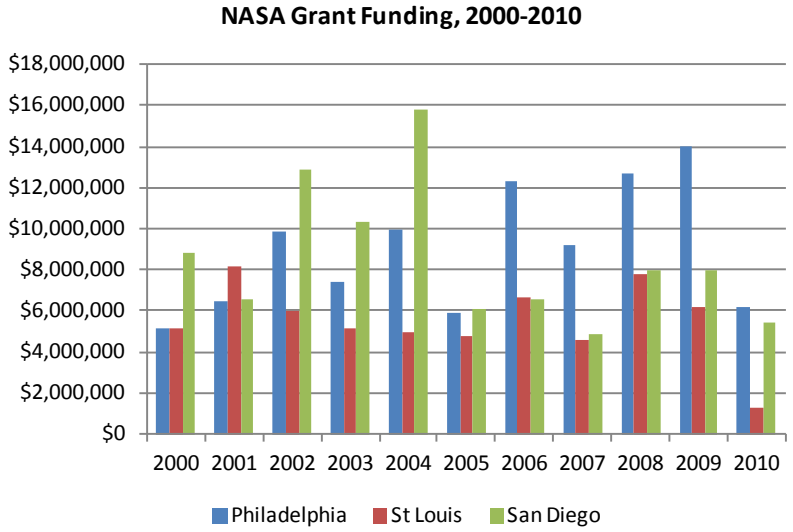
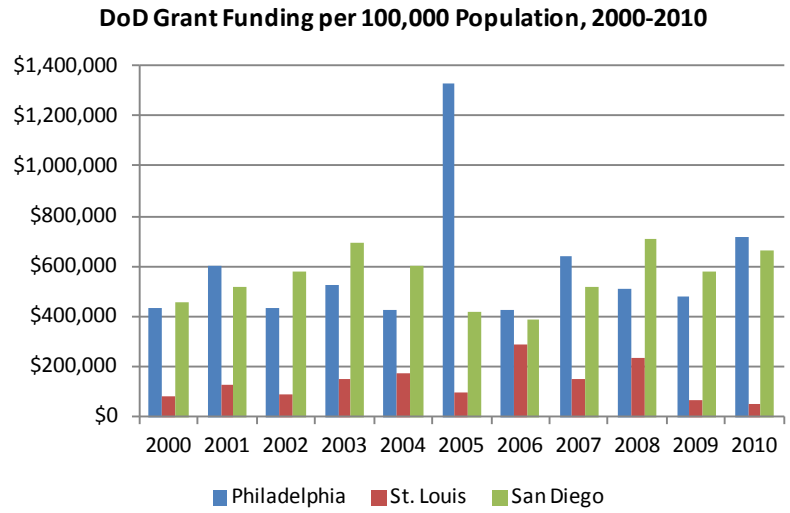
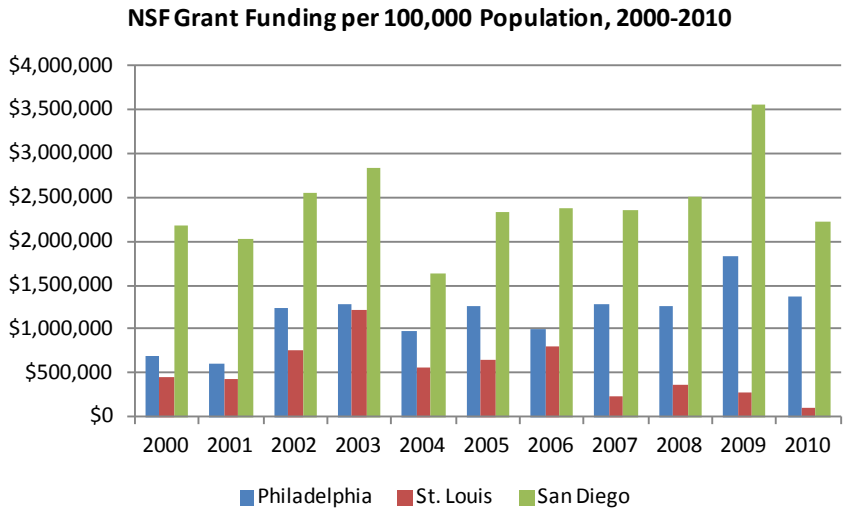
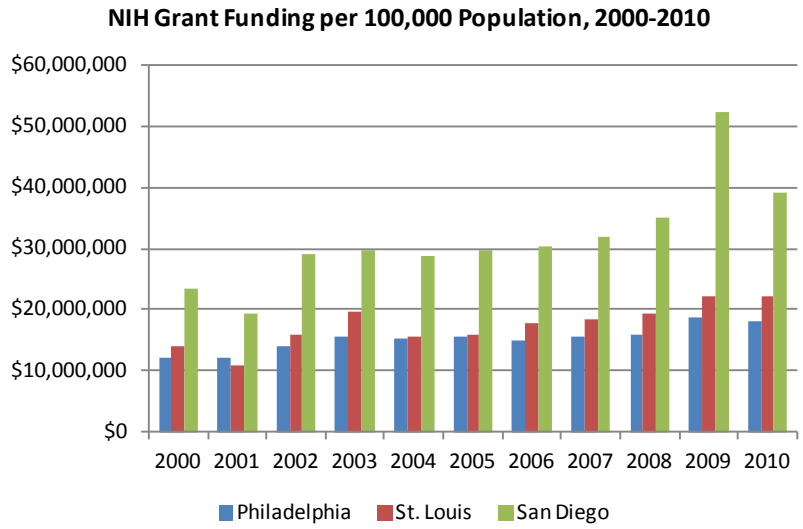
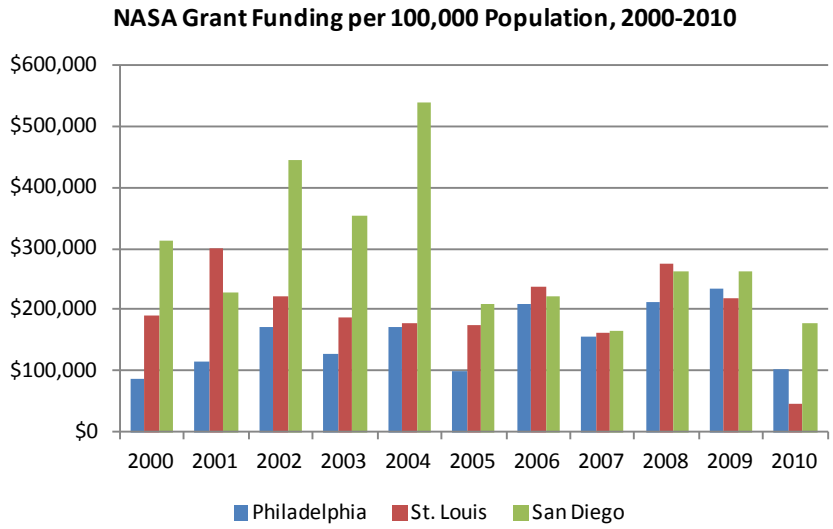


Figure A-3: Federal R&D Funding per 100,000 Pop., 2000-2010

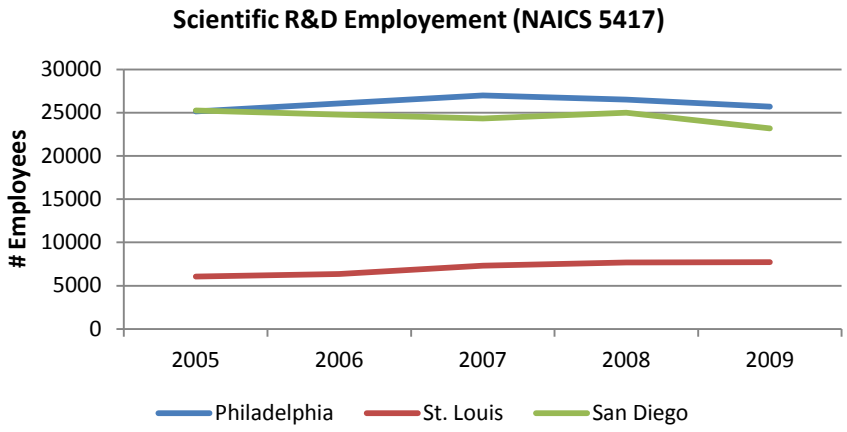


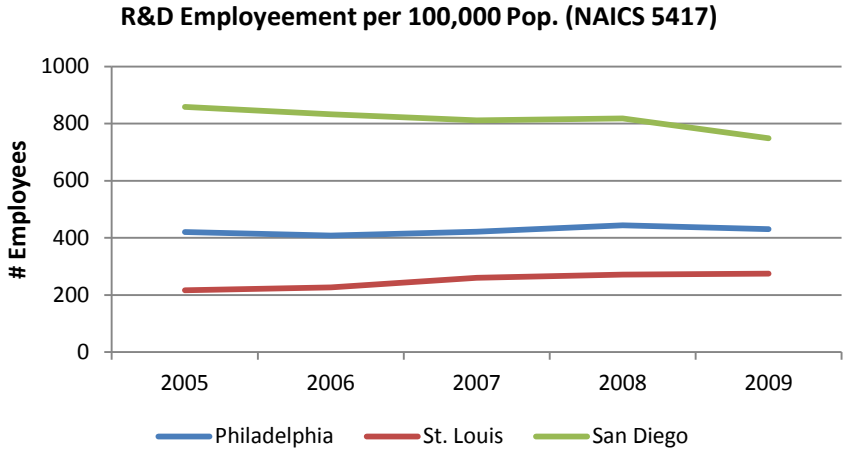


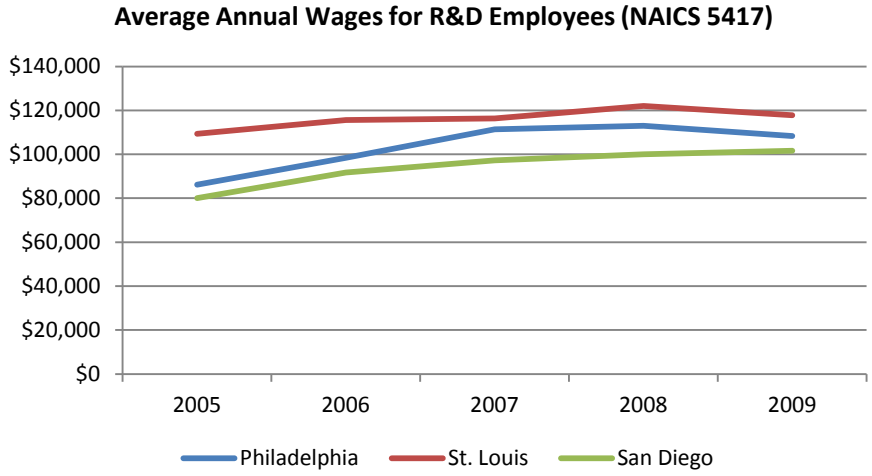




FigureA- 4: R&D Employment and Average Annual Wages (NAICS 5417)







Source: US Bureau of Labor Statistics, Quarterly Census of Employment and Wages (QCEW)

Table A-6: Patent Application Assignees, 2005-2009

PHILADELPHIA MSA	
PATENT APPLICANTS	**NO. OF APPLICATIONS**
E.I. DU PONT DE NUMOURS	422
WYETH	409
INTERDIGITAL TECHNOLOGY	338
SIEMENS	210
BRISTOL-MYERS SQUIB	188

ST. LOUIS MSA	
PATENT APPLICANTS	**NO. OF APPLICATIONS**
BOEING	300
PFIZER (INCL. MONSANTO AND PHARMACIA)	244
MEMC Electronic Materials, Inc.	54
WASHINGTON UNIVERSITY ST. LOUIS	52
EMERSON ELECTRIC	48

SAN DIEGO MSA	
PATENT APPLICANTS	**NO. OF APPLICATIONS**
QUALCOMM, INC	2042
SONY CORPORATION	359
REGENTS OF THE UNIVERSITY OF CALIFORNIA	250
SCRIPPS RESEARCH INSTITUTE	201
BROADCOM CORPORATION	114

Source: US Patent & Trademark Office

Table A-7: Patent Grant Assignees, 2005-2009

PHILADELPHIA MSA	
PATENT GRANT ASSIGNEES	**NO. OF GRANTS**
E.I. DUPONT DE NEMOURS	1215
BRISTOL-MYERS SQUIBB	430
ROHM AND HAAS ELECTRONICS	288
WYETH	249
MERCK	219

ST. LOUIS MSA	
PATENT GRANT ASSIGNEES	**NO. OF GRANTS**
BOEING	295
PFIZER (INCL. MONSANTO AND PHARMACIA)	280
EMERSON ELECTRIC	126
MALLINCKRODT INC.	52
G.D. SEARLE	45

SAN DIEGO MSA	
PATENT GRANT ASSIGNEES	**NO. OF GRANTS**
QUALCOMM, Inc.	1155
HEWELETT PACKARD DEVELOPMENT CO.	455
CALLAWAY GOLF	352
SONY	309
THE REGENTS OF THE UNIVERSITY OF CALIFORNIA	263

Source: US Patent & Trademark Office

Figure A-5: Number of Events Reported by Intermediary Organization*

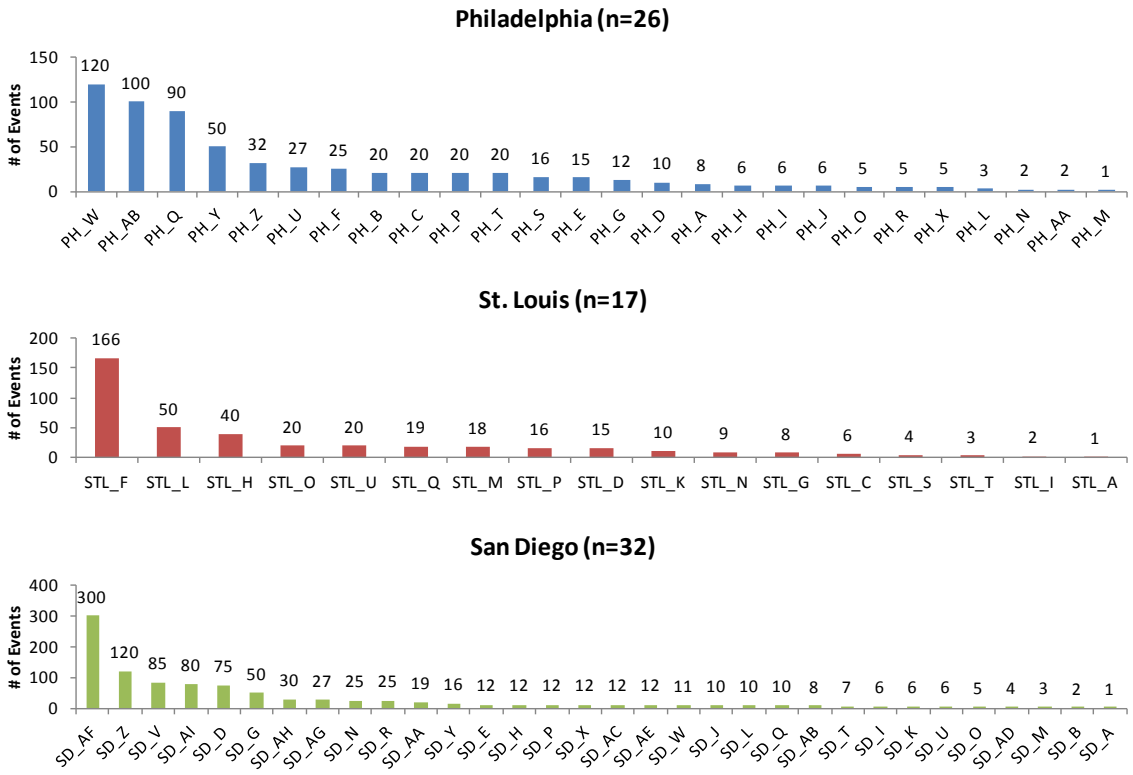
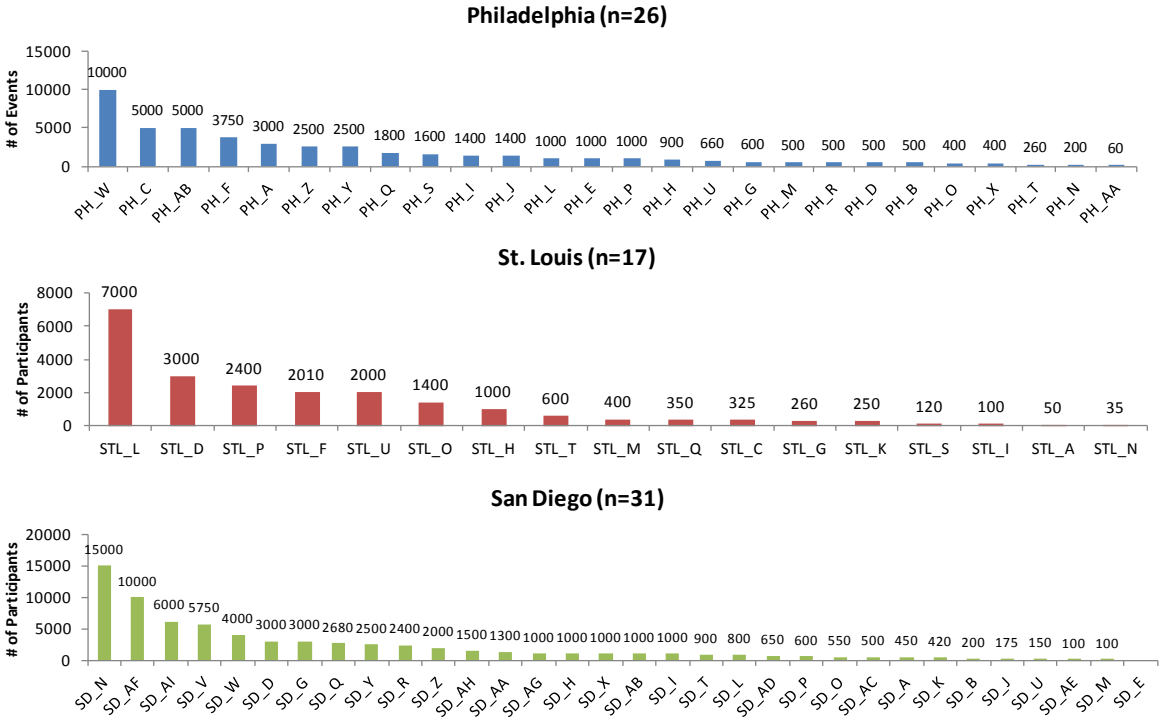


Figure A-6: Number of Participants Reported by Intermediary Organization



*Note: Code names for the organizations have been used to ensure confidentiality.

Figure A-7: Number of Volunteers Reported by Intermediary Organization

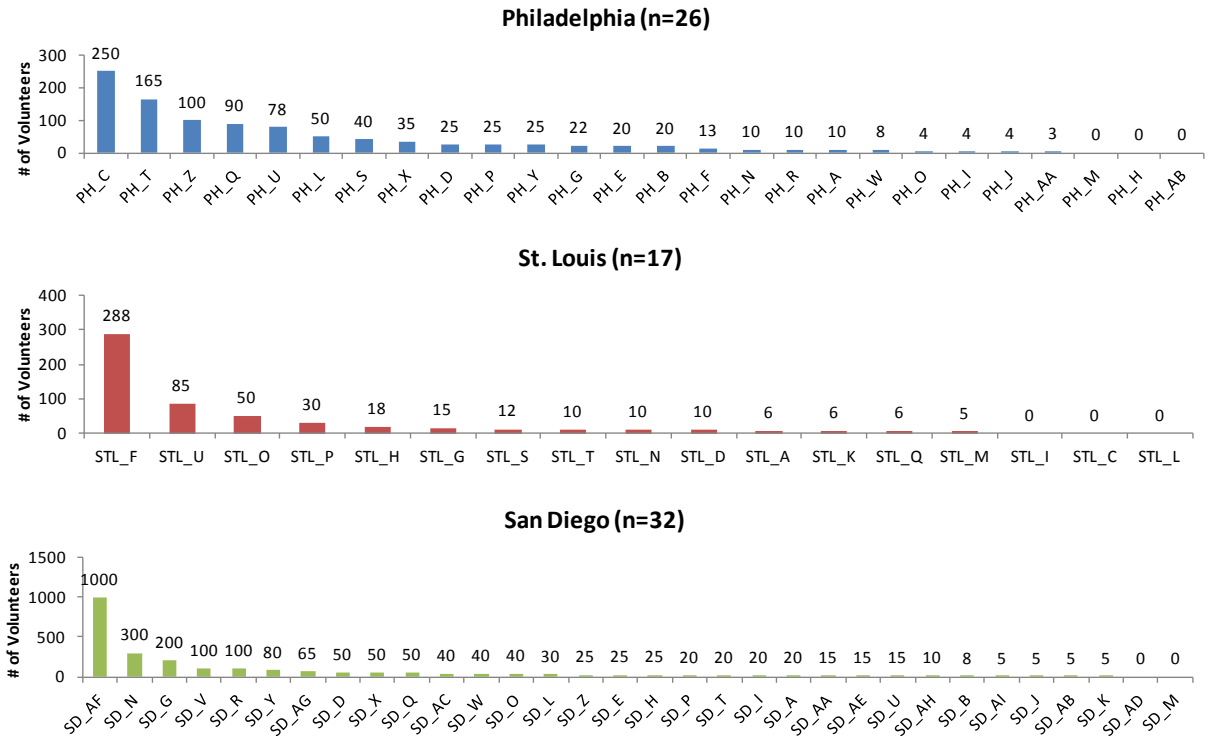


Figure A-8: Entrepreneur Responses to Whether They Utilize Intermediary Organizations in Their Region

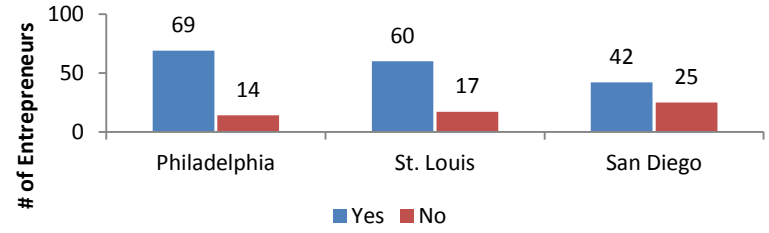


Figure A-9: Reported Frequency of Entrepreneur Participation in Intermediary Organization Activities

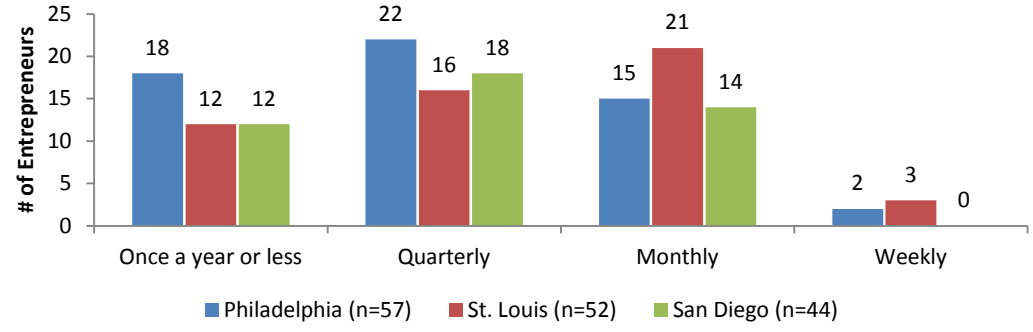


Figure A-10: Reasons Entrepreneurs Reported for Not Participating in Intermediary Organization Activities (Multiple Reasons Allowed)

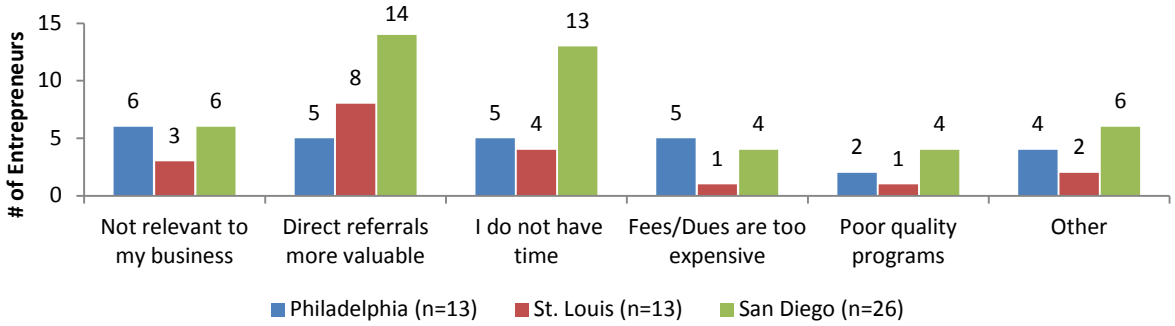


Figure A-11: Entrepreneur Ratings of Regional Characteristics (1-5 Scale, 5 Being Highest)