



INNOVATION BY DESIGN:

The Regional Impact of the
Cortex Innovation Community

Prepared For:
Cortex Innovation Community

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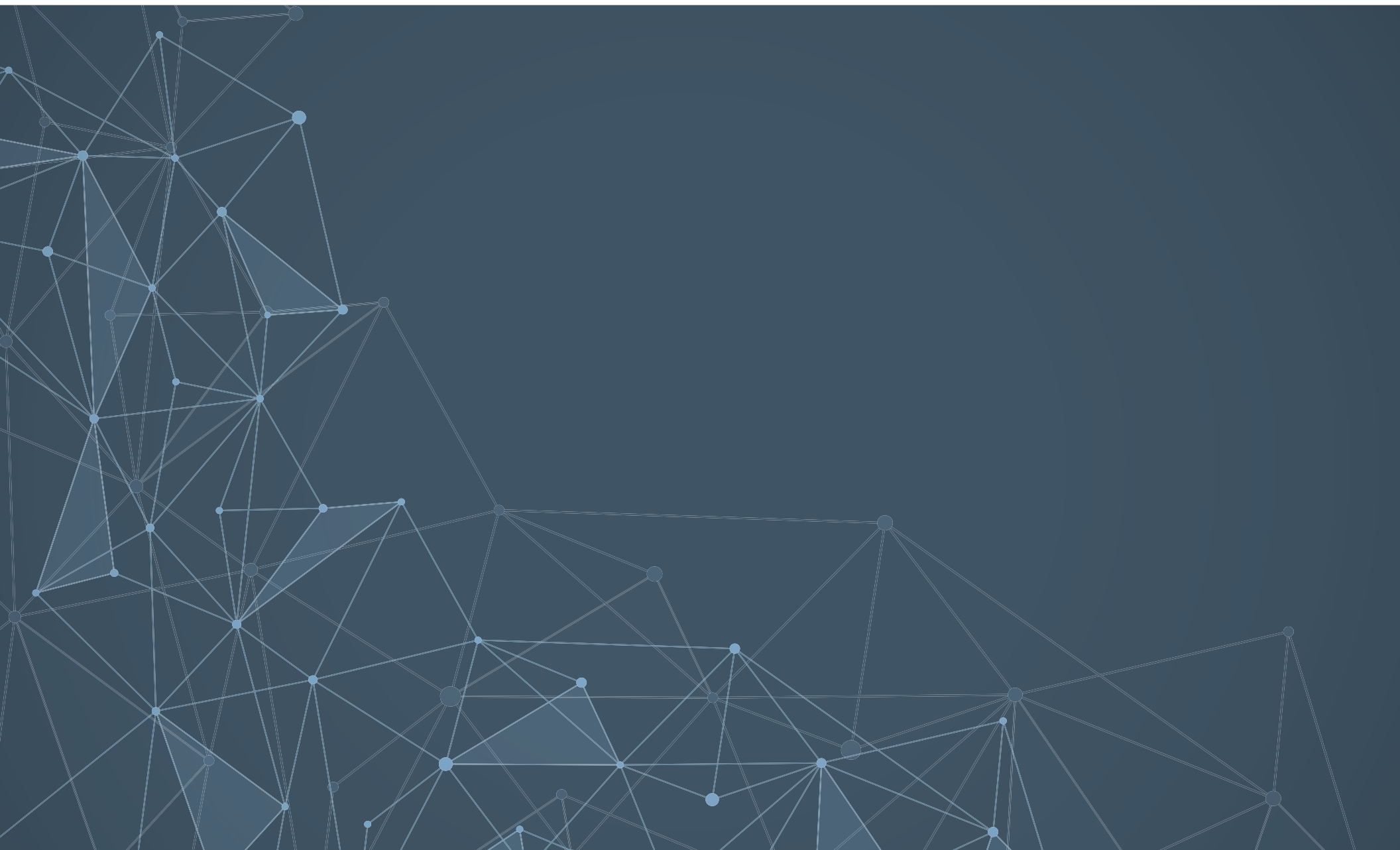
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EXECUTIVE SUMMARY

ABSTRACT

This study details the economic and functional impacts of the Cortex Innovation Community within the St. Louis region. Using quantitative input/output (I/O) analytics, the report profiles the economic output and employment impact of business and institutional operations and developments located in Cortex. The results clearly demonstrate that Cortex is a powerful, and growing, economic engine for the region, with 5,780 employees currently working in the Cortex Innovation Community and the economic activity of operations at Cortex generating \$2.1 billion in economic output impacts for the St. Louis region in 2018. Cortex is also expanding the regional tax base. I/O analysis shows \$69.6 million in total Cortex-related state and local tax revenues for 2018, and \$185.4 million in federal taxes (primarily payroll taxes) generated. Over the 30 year life of the Cortex Super TIF, it is projected that over \$775 million in TIF revenues will be generated. The report also highlights the multi-faceted pathways by which Cortex stimulates economic and community development and reinforces the development of a robust technology-based economic development ecosystem – an ecosystem that positions the region well for ongoing success in an increasingly competitive global innovation-powered economy. It is also found that Cortex, its development partners and key stakeholder institutions demonstrate a robust commitment to inclusion and social equity – with specific Board policies and a series of programs and initiatives designed to promote inclusion and high-levels of community engagement.





INTRODUCTION

The St. Louis region faces intense global competition. As nations, states and metropolitan areas compete for advanced industries and the high-paying jobs associated with the innovation economy, it has become clear that the quality of a place – the local conditions that make a location desirable for commercial activity and the attraction and retention of a skilled and educated workforce to power that activity – matters enormously.

To be successful, regions must assemble a complex mix of assets into a fully functioning technology-enabled and innovation-driven ecosystem in order to thrive under current and future economic pressures and competitive forces.

As noted by the Brookings Institution and other leading thinkers in advanced economic development, there is an evident modern preference for technology and advanced-industry activities to agglomerate in relatively concentrated spatial areas. Whereas research parks have been the traditional site for such activity in previous decades, modern preferences favor **mixed-use live/work/play/learn developments** that concentrate a diversity of assets and supporting infrastructure into a dynamic environment preferred by the technology workforce and the innovative companies that employ them. These concentrated, mixed-use, technology-based economic development (TBED) districts are now commonly termed “Innovation Districts.”

St. Louis, with the development of the Cortex Innovation Community, is recognized as being among the pioneers in Innovation District placemaking. Rooted in formal technology-based economic development (TBED) strategic planning work for the region, performed in 2000, visioning for Cortex began in 2005 with development of a district master plan to develop 200-acres of land in the City of St. Louis between St. Louis University in the East and the Washington University and BJC academic healthcare complex in the West. Strategically located adjacent to leading research universities, and supported directly by Washington University in St. Louis, the University of Missouri St. Louis, St. Louis University, BJC Healthcare and the Missouri Botanical Garden as founding partners, Cortex represented a bold vision for urban placemaking specifically directed at advancing the St. Louis regional economy in technologically-oriented innovative industries. As reported herein, Cortex has achieved substantial momentum and achieved significant success (particularly since 2010) in accommodating growth in the regional innovation economy.

CORTEX DEVELOPMENT HISTORY

The Cortex Innovation Community story is a tale of two phases. The early phase of the development, spanning 2002-2009, emphasized bioscience and saw the development of Cortex I as a multi-tenant office and lab building, and the build-to-suit development of the Solae (now DuPont Nutrition and Health) soybean R&D facility. In this first phase, development progressed at a moderate but notable pace, and by the close of 2009 Cortex was home to operations of 35 companies and institutions.

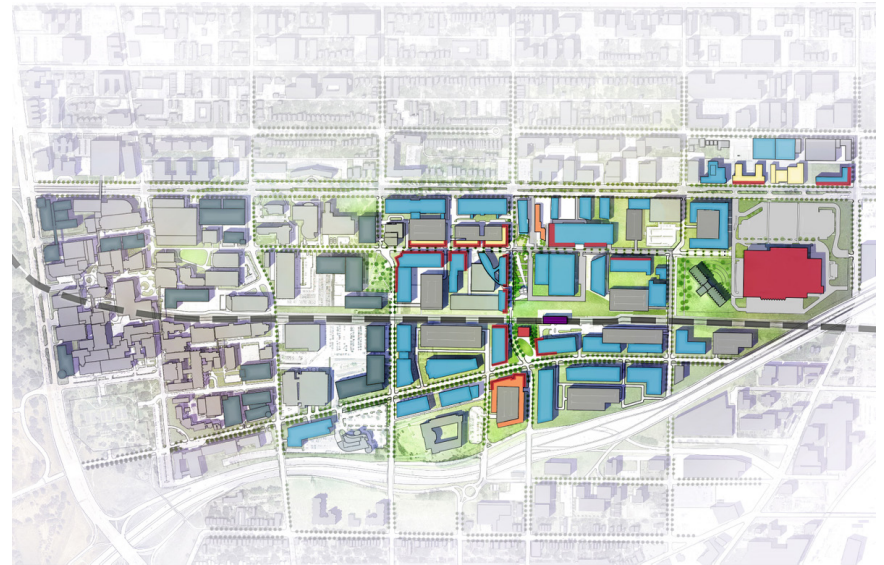
Seeking to propel the development to a higher level of performance, the Cortex Board modified the operational management of the development in 2010, recruiting an experienced President and CEO, supported by a staff of 10 professionals. Notably, the Cortex Board and the President and CEO saw a strategic need to pivot the organization from solely focusing on bioscience to a broader vision of Cortex as a hub for any advanced technology and for associated support services and institutions. This pivot was very much on-point and visionary in early recognition of the emerging trend of “convergence” – i.e. the tendency for innovation to occur at the intersection of multiple, traditionally separate, disciplines and industries. By opening Cortex to companies in bioscience and in other technology spaces (such as information technology, data analytics, advanced manufacturing, logistics, material sciences and other sectors) opportunities for novel combinations of technologies and capabilities could and would be realized. The decision to embrace other sectors was especially prescient in terms of attracting companies in digital technologies, programming and advanced analytics that today are proving to be central to the ongoing “digitalization of everything” movement being experienced across almost all areas of commercial growth.

Since the 2010 hiring of the new management team and associated supportive Board actions Cortex has experienced significantly enhanced development momentum – and the results speak for themselves. **Today Cortex accommodates more than 10 times the number of companies that were in the district at the end of its first 8 years of operation.**

The early and ongoing development of Cortex is a testament to the vision and civic commitment demonstrated by the Cortex founding partners (Washington University in St. Louis, the University of Missouri St. Louis, St. Louis University, BJC Healthcare and the Missouri Botanical Garden) and the Cortex Board. Founding partners stepped forward to invest \$29 million in initial capital and to leverage their assets and balance sheets, providing loan guarantees and committing to leasing significant space in the district securing early financial viability for development. The City of St. Louis and other governmental stakeholders were similarly supportive, showing foresight and flexibility in planning actions, infrastructure improvements and enabling a Super TIF for the district. Guided by a diverse and highly engaged Board, Cortex is an example of civic visioning and collaboration at its best.

Beyond embracing convergence and diversity in sectors, part of the strategy that led to the new development momentum between 2010 and 2018 was the opening-up of Cortex to a diverse set of collaborations and development partnerships, with engagement of experts from Wexford Science + Technology, Cambridge Innovation Center, Venture Café and experienced local TBED organizations such as the Center for Emerging Technologies (CET) and BioGenerator. As highlighted in detail within this report, the Cortex Innovation Community now benefits from accommodating and having established a complete on-site technology-based economic development ecosystem that is very well connected to regional education and workforce development programs, innovation assets, capital sources, and is supported by high quality real estate that meets the needs of entrepreneurial and fast-growth business enterprise. As a result of the strategic changes embraced since 2010, **Cortex is now a well-recognized exemplar of the power and promise of innovation district development.** Plus, the positive momentum is continuing with multiple recent accomplishments:

- Access to Cortex has been substantially enhanced through the opening of the Cortex MetroLink light-rail station and the completed construction of a new I-64 highway interchange directly into the district.
- More than 2 million square feet of development has now occurred in Cortex with investment exceeding \$700 million.
- The District has evolved to become not only the favored destination for innovative entrepreneurs and start-up business ventures but also a key hub for large companies such as Microsoft, Boeing, AB Mauri, Express Scripts and Emerson seeking to locate in the district to access the dynamic environment, creative energy and opportunities for partnerships generated in the district.



- Operations of research universities, including academic research teams and technology commercialization teams, opening and expanding within Cortex.
- The development mix now diversifying with new retail, dining, hotel and residential accommodations developed, under-development or well-along in their planning.

ECONOMIC IMPACTS BEING GENERATED BY THE CORTEX INNOVATION COMMUNITY

Cortex is now home to the operations of 369 companies and institutional tenants, with daily district employment totaling 5,780. Not surprisingly, the economic activity associated with the maturation of Cortex as a leading hub for entrepreneurial, existing industry and institutional R&D and innovation activity is substantial.

The operational purchases of Cortex and its 369 tenants generate substantial direct and indirect economic impacts as does the spending of the Cortex Innovation Community’s workers. Using input/output analysis, TEconomy has quantified both the direct impacts of operational expenditures and the 5,780 direct jobs, and also the economic ripple effects (multiplier effects – both indirect and induced) occurring throughout the MSA.¹

In total the direct economic activity within the Cortex Innovation Community is shown to generate more than \$1 billion in output within the MSA in 2018 (Table ES-1). The 5,780 direct jobs provide \$450 million in wages and benefits.

The broader regional economic impact includes additional indirect and induced impacts through the multiplier effect. Taken together,

Table ES-1: Economic Impact of Cortex Innovation Community, 2018 (\$M)

Impact Type	Employment	Labor Income	Output	State/Local Tax Revenue	Federal Tax Revenue
Direct Impact	5,780	\$449.8	\$1,019.7	\$24.4	\$94.9
Indirect Impact	2,895	\$178.7	\$472.4	\$13.4	\$39.7
Induced Impact	4,477	\$211.3	\$640.6	\$31.9	\$50.8
Total Impacts	13,152	\$839.8	\$2,132.7	\$69.6	\$185.4
Multiplier	2.28	1.87	2.09		

Source: TEconomy Partners analysis; St. Louis MSA (15 Counties) IMPLAN model.

1 For the purposes of this analysis, the St. Louis Region is synonymous with the St. Louis Metropolitan Statistical Area (MSA) which consists of both Missouri regions (St. Louis City, and Franklin, Jefferson, Lincoln, St. Charles, St. Louis, and Warren counties) and Illinois regions (Bond, Calhoun, Clinton, Jersey, Macoupin, Madison, Monroe, and St. Clair counties).



indirect (spending by regional operations in support of their business with Cortex-based operations) and induced impacts (expenditures by personnel servicing Cortex-based economic activity) generate an additional 7,372 jobs in the St. Louis regional economy, for a **total regional employment impact of 13,152 jobs**. This represents a 2018 employment multiplier of 2.28 — meaning that for every 1 Cortex direct job another 1.28 jobs are generated in the St. Louis MSA.

From an economic output perspective, **the Cortex Innovation Community generates and supports a total economic impact of more than \$2.1 billion across the St. Louis region**. For every \$1 in Cortex output an additional \$1.09 in output is generated by other regional firms for an output multiplier of 2.09. These direct, indirect, and induced impacts are estimated to generate nearly \$70 million in state/local tax revenues and \$185.4 million in federal tax revenues.

In part these tax revenues, in turn, help support the public investment and incentives used for the asset and infrastructure improvements required to support Cortex development.

The rise of Cortex as a successful innovation district has also significantly improved the value of surrounding real estate. Analysis presented herein shows that the two zip codes in which Cortex is located have experienced growth in property values above the average for the City of St. Louis and St. Louis County region, with the Cortex-containing zip 63110 achieving the highest growth rate in property values (49.4%) of any regional zip examined over the 2004-2018 period analyzed.

FUNCTIONAL IMPACTS OF THE CORTEX INNOVATION COMMUNITY

The Cortex Innovation Community has evolved to fill important functions for the region, accommodating a broad-range of key TBED ecosystem elements.

As illustrated in Figure ES-1, Cortex is: a hub for R&D and associated innovation activities; home to a diverse range of innovation centers and entrepreneur support services designed to accelerate the growth of innovative companies; a hub for regional risk capital access; a dynamic live/work/play/learn environment conducive to innovation activities and the skilled human capital that power innovation and associated business growth; a connected environment with robust transportation linkages and is integrating to benefit surrounding neighborhoods; a center for education and training activities in STEM disciplines and in jobs for the future; and a signature place in St. Louis attracting visitors to conferences and events and active in outreach and marketing activities.

This Cortex-enabled ecosystem is generating very real results for the region. Core tenants at Cortex have generated 194 patents and patent applications since 2010 with a particularly strong presence in bioscience technologies. Thirteen companies located in Cortex have been recipients of major federal SBIR or STTR funding awards to advance their technologies, with many of these companies having attracted multiple such awards. TEconomy's analysis of Pitchbook data show a healthy business funding environment evolving at Cortex, with 58 current Cortex tenant companies raising over \$392 million in investment capital provided by 113 active investor organizations.

Figure ES-1: Functional Impact Themes Across Cortex



Figure ES-2: The Cortex Innovation Community Ecosystem – Services and Providers

		Ecosystem Element Providers																
		<div><div>In District</div><div>External</div></div>		CORTEX	CET	BioSTL	BioGenerator	Capital Innovators	CIC St. Louis	City of St. Louis	Cultivation Capital	Individual Tech Co's.	iSelect	MADE	MedLaunch	Research Universities (WUSTL, SLU, UMSL)	Sling Health STL	Venture Café St. Louis
Primary Provider/Performer		★	☆															
Secondary		●	○															
Ecosystem Element																		
Basic Research												●				★☆		
Applied Research												★				★☆		
Piloting and Scale-up Facilities & Lab Services		●			★				●			●			●○	★☆	●○	
Technology Transfer and Licensing																★☆		
Pre-Seed/Seed Capital					★	★					★		★		●	●○	●	
Venture Capital					★	★					★		★					
Tax Abatements/TIF/ Credits/Dev. Assistance		★								○								
Incubator/ Accelerator Facilities		●	★		★			★						○	○		○	
Master Planning & Development Management		★																
Office/Flex Space Development/Leasing		●	●		●			★								●		
Entrepreneurial Development & Mentoring			★	○	★	●					●	●	●		★		★	
Education & Workforce Development Services				○	●					○						★☆		
Networking Events & Intellectual Exchange			●	○	●				●			●				○		★
Community Engagement Outreach		★								○		●				●○		●
SBIR/STTR Assistance and Coaching			★		★											○		
Business Attraction and Marketing		★		☆						☆								

As illustrated and summarized on Figure ES-2, the comprehensive ecosystem that has developed at Cortex provides new and fast-growing business enterprises with access to:

- Coworking, incubator and accelerators space
- Lab space and specialized prototyping, pilot and scale up equipment
- Formal training programs in entrepreneurship and business venture management
- Skilled business advisors, mentors and professional services providers
- Training and support for accessing capital from pre-seed through to advanced VC financing rounds
- Expertise in IP protection, technology transfer and intellectual property licensing.
- 22 core scientific research facilities at area universities and research institutions.

Perhaps most important of all, Cortex provides a location where informal and formal “collisions” between innovators, entrepreneurs and service providers are encouraged, facilitated and supported.

The name of the district, the Cortex Innovation Community, embraces and celebrates the importance of the networks, collaborations and cooperative opportunities that Cortex now accommodates. This community facilitates discussions of new and disruptive technologies, trends and opportunities in technology convergence, and the emergence of new business models and business megatrends. As home now to a diverse set of institutions and enterprises, both large and small and spanning a broad suite of business sectors, the Cortex Innovation Community has now reached a critical mass whereby networking and interfirm connections will be conducive to sparking creative collaborations and accommodating new convergence trends. This community aspect of Cortex is particularly notable and visible in the strong attendance at Venture Cafe's Thursday Gatherings. On average, between 400 and 500 people attend the Thursday Gatherings each week to connect with each other as a community interested in all fields and aspects of innovation. Hosted from 3pm to 8pm at the 4240 Duncan Avenue building, the Venture Cafe Gathering has become the go-to place for innovators, entrepreneurs and creative thinkers to connect.

DIVERSITY AND INCLUSION AT CORTEX

The City of St. Louis, and the St. Louis region, benefits from a diverse population, and it is important that economic development work is performed that supports employment inclusivity for all populations.

With Cortex focused on innovation- and technology-based economic development, inclusion needs to receive particular attention because the tech-sector overall in the U.S. has tended to demonstrate inclusivity challenges both in terms of race/ethnicity and gender employment profiles. The large IT sector of the tech economy, for example, is generally more Caucasian in its employment profile than private sector industry overall in the U.S., and the sector particularly underperforms in terms of percentage of black and female workforce participation. Analysis by the College Board shows that employment disparities in tech sectors are largely a reflection of STEM education access across

populations – with disproportionately low numbers of women, black and Hispanic students achieving credentials in STEM disciplines.

Recognizing the challenges, Cortex and key stakeholders in the Cortex Innovation Community ecosystem have engaged in a series of programs and initiatives designed to address inclusivity. The Cortex Board of Directors Inclusion Committee provides direction and guidance to assure that inclusion and social equity are a core component of development strategy. Cortex has a series of initiatives, including: enacting organizational governance, advising and operational policies and guidelines to assure inclusion is a core focus; encouraging equity in entrepreneurship and new business development, and assuring construction projects within Cortex are inclusive in their employment and contractor profiles (with goals for contractor engagement met or exceeded). Cortex has also been a stakeholder in developing the Collegiate School for Medicine and Biosciences as an urban magnet STEM school (which most recently saw 53% of its students being black, 23% Asian, and 22% white). The Executive Committee of the Cortex Board has approved an annual commitment of \$125,000, over ten years, toward initiatives that support Cortex goals of inclusion and equity. In addition to programs of Cortex itself, several key organizations operating in the Cortex Innovation Community also have specific initiatives focused on inclusion. Examples include: BioSTL operating the Bioscience & Entrepreneurial Inclusion Initiative; BJC with the Connections program focused on encouraging diversity in the health sciences workforce; CET with its Diversity in Mentoring program and focused programs to recruit women and people of



color into its entrepreneurship programs²; CIC working with the Diversity Awareness Partnership and having a Racial Equity team of staff members; and Venture Café seeking to support innovators of all backgrounds, encourage social mobility, and powering EdHub (an initiative developed in direct response to a Call to Action from the Ferguson Commission Report).

Assuring that the St. Louis region meets the workforce needs of technology sectors and advanced industries is not an easy task, especially given the intense competition for skilled personnel experienced both nationally and internationally. The St. Louis region's demographic profile means that all organizations within the Cortex ecosystem will particularly need to engage around inclusion in STEM education to assure an appropriate pipeline is built between regional schools, higher education institutions, retraining and skills development organizations and the expanding cluster of tech enterprise contained in Cortex. Such engagement is evident, but likely needs to be emphasized more in order to fully respond to anticipated needs.



2 Square One Bootcamp, Square One Ignite and Level Next.

CONCLUSION

The Cortex Innovation Community has a deserved reputation as an exemplar among the United States growing cadre of innovation districts. Particularly since a restructuring of management in 2010, Cortex has been on a highly successful development trajectory.

Today, with over \$700 million in investment and 2 million square feet of space, Cortex is a dynamic mixed-use environment and the go-to hub for small and large technology-oriented business ventures and institutions in the St. Louis region. The Innovation Community is now home to 369 companies, spanning a diversity of science, technology and innovation sectors, and Cortex benefits from operation of a holistic TBED ecosystem providing access to specialized facilities, infrastructure, expertise, capital and guidance necessary to advance fast-growth enterprise.

The characteristics of the Cortex Innovation Community, as a dynamic hub for innovation and creativity, have now resulted in Cortex being “on the radar screen” of major established companies seeking to place operations in the type of dynamic innovation district environment that Cortex has fostered. By creating an environment favorable to entrepreneurs, to expanding businesses, to innovative operations of large companies, and to universities and R&D performing institutions, Cortex has strategically managed to place itself in the enviable position of being a recognized, signature placemaking initiative that delivers on the type of environment favored by modern technology enterprises and attractive to the skilled workforce that these industries require.

As home to 5,780 direct jobs, the economic impact of Cortex on regional employment and business output is significant and expanding. TEconomy finds that total economic impact associated with Cortex at the close of 2018 stood at more than \$2.1 billion with a total of 13,152 jobs in the MSA driven by Cortex economic activity. Furthermore, the investment by government, in granting TIF authority and other incentives to development, is paying off. Projections for revenues generated by Cortex-based development and operations over the 30 year projection period point to over \$775 million in combined TIF generated revenues for the State of Missouri, City of St. Louis, St. Louis City Schools and multiple public agencies. TEconomy’s input/output analysis shows almost \$70 million generated in state and local tax revenues in 2018.

All involved in the development of Cortex should be proud of the work accomplished to-date, but moreover the region can anticipate many further benefits to come as Cortex helps to cement St. Louis’ position in a highly competitive global economic race for technology jobs and innovation.

I. INTRODUCTION

A. THE IMPORTANCE OF PLACE IN A GLOBAL ECONOMY

“Globalization describes the growing interdependence of the world's economies, cultures, and populations, brought about by cross-border trade in goods and services, technology, and flows of investment, people, and information.”³

Globalization was anticipated to be a rising tide that would raise all ships, providing opportunities for both developed and developing nations alike to participate in rapidly expanding trading opportunities. The reality, however, is that the recent era of intense and expanding global competition has promoted the development of regional winners and losers. In the U.S. this is readily apparent, with significant disparities in the relative economic performance of major metro areas and states. What has happened, in an interesting paradox, is that the more globally integrated and dependent the U.S. economy has become the more **local conditions matter**. The presence of the right mix of assets in research and development, education, entrepreneurial know-how and culture, workforce skills, capital availability, and face-to-face social networks matter, very much, for economic success and they are far from evenly distributed across the United States (see sidebar).

It is now evident that the importance of place for regional development is being expressed in a preference for highly concentrated

development assets co-located within a relatively compact spatial area. The previous generation of technology-enabled enterprises tended to favor research or science park developments, often in suburban settings. Research Triangle Park, in North Carolina, is the ultimate expression of that previous model – a sprawling development of separate business “campuses” located on a 7,000 acre site. This preferences of businesses (especially technology businesses) have recently transitioned, however, with a realization that the attraction of a modern technology workforce is better accomplished and accommodated through an urban, higher-density, mixed-use live/work/play/learn environment. The term “Innovation District” is used to describe these concentrated urban entrepreneurial place-based ecosystems. The Brookings Institution defines Innovation Districts as:

Dense enclaves that merge the innovation and employment potential of research-oriented anchor institutions, high-growth firms, and tech and creative start-ups in well-designed, amenity-rich residential and commercial environments. Inno-

³ The Peterson Institute for International Economics (PIIE). “What Is Globalization? And How Has the Global Economy Shaped the United States?” Accessed online at: <https://piie.com/microsites/globalization/what-is-globalization.html>

The Uneven Economic Adjustment of Older U.S. Industrial Cities

The Brookings Institution recently assessed the relative performance of 70 older U.S. industrial cities as they transition and adjust to the global knowledge- and technology-driven economy. They found substantial disparities.

Brookings concludes that the St. Louis region is better positioned for success than most – comprising one of just 16 metro areas in their highest-rated “strong” classification. Interviewed by St. Louis Public Radio, the Brookings authors noted that St. Louis has been “one of the stronger economies in terms of good job creation. Incomes and employment are increasing at faster rates locally than they are in a lot of older industrial cities.”

vation districts facilitate the creation and commercialization of new ideas and support metropolitan economies by growing jobs in ways that leverage their distinct economic attributes. These districts build on and revalue the intrinsic qualities of cities: proximity, density, authenticity, and vibrant places.⁴

Now, and into the foreseeable future, economic development is very much a function of place making – mandating that strategic attention be paid to building relatively compact, geographically bounded districts in which the development of a robust ecosystem facilitating and accommodating technology-based, entrepreneurial business development can best occur. The value of an Innovation District is derived not only from the presence of an appropriate mix of physical facilities but also by the role the district plays as an “agora” for development – a gathering place bringing together the tacit know-how and assets of a region’s industries, talent, and research institutions together with the capital, infrastructure and support services needed to grow and expand innovative business enterprise.

Innovation Districts are increasingly being seen as key assets for promoting modern economic development, generating a dynamic, attractive and spatially compact community that appeals to entrepreneurial industries and the skilled talent they require for success. Innovation Districts are environments that are attractive to skilled talent and foster interpersonal interactions. They are collaborative environments that facilitate innovation and promote the development, transfer, and commercialization of technology by providing an identified, bounded and branded location in which companies, entrepreneurs, and research institutions and their high-skilled talent base operate in close proximity.

⁴ Brookings Institution. “Innovation Districts.” Accessed online at: <https://www.brookings.edu/innovation-districts/>

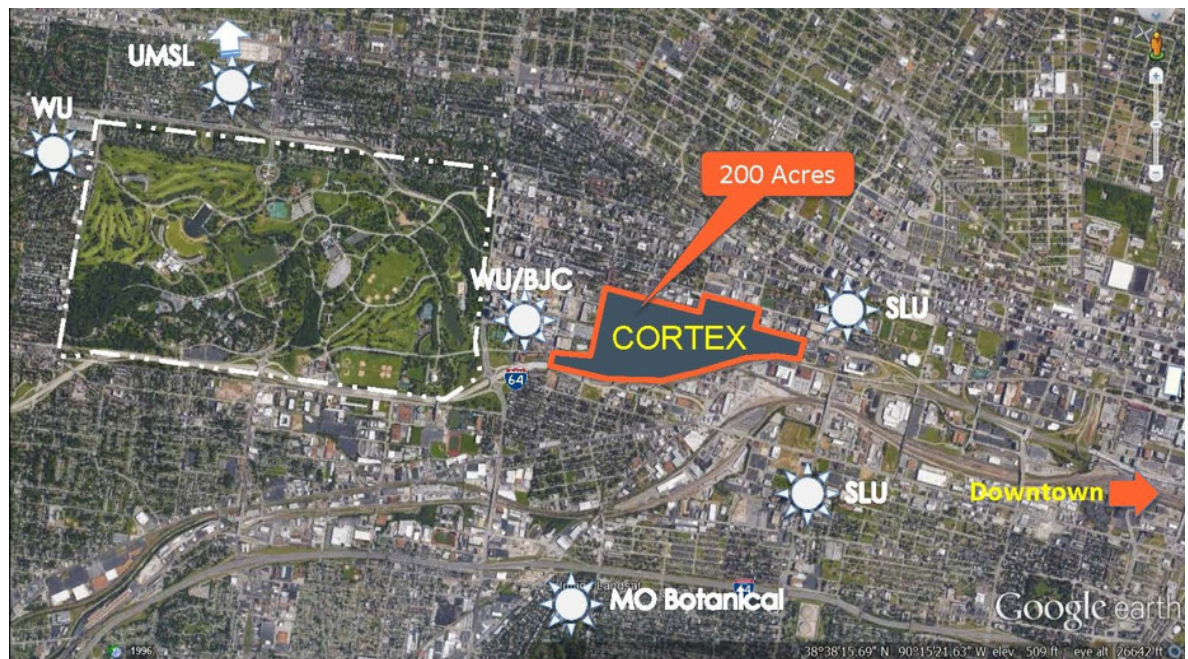
B. CORTEX – PLACEMAKING HISTORY

A key reason for St. Louis being recognized as a “strong” environment for growth and redevelopment by Brookings is embodied in the region’s early recognition of the importance of placemaking to advance economic development.

In September of 2000, TEconomy’s fore-runner organization, the Battelle Technology Partnership Practice⁵, performed a pivotal study for the St. Louis region that provided a detailed roadmap for advanced technology-based economic development within the St. Louis region. The strategy outlined the need for a focusing of assets and efforts in technology-platforms (concentrated areas of technology development rooted in established and emerging regional core competencies) facilitated by the development of a robust innovation and entrepreneurship ecosystem and concurrent place-making developments to facilitate ecosystem activities. In 2001 the Coalition for Plant and Life Sciences (now named BioSTL) was formed to implement the regional strategy in the biosciences platform, providing leadership for strategy implementation. The first major project of the Coalition was the development of the now world-renowned Donald Danforth Plant Science Center. The success of the Danforth Center spurred regional leadership to look towards the further growth of St. Louis as a bioscience hub, with Washington University in St. Louis, the University

of Missouri St. Louis, St. Louis University, BJC Healthcare and the Missouri Botanical Gardens becoming the founding partners for the next regional development hub. Modelling their efforts, in part, on the successful ecosystem in the Kendall Square district of Boston, the partners sought to pursue an innovation place-making initiative

Figure 1: Cortex and Surrounding Geographic Context



⁵ In November of 2015, TEconomy Partners, LLC was established as a focused technology-based economic development (TBED) consultancy transitioning the full staff and assets of the Battelle Technology Partnership Practice into an independent organization separate from the Battelle Memorial Institute. TEconomy continues a three-decade legacy of pioneering analysis and strategy in TBED to advance modern economic development in states, regions and communities within the U.S. and internationally.

in the urban heart of the City of St. Louis with a special emphasis on proximity to the universities and the academic medical center community. The concept sought to build-upon core institutional R&D expertise in bioscience and also create a physical environment that would facilitate interactions, innovation, start-up enterprise formation and business attraction in biosciences through ready access to university expertise, talent, lab and instrument resources, and intellectual property. The founding partners created the Center for Research Technology and Entrepreneurial Exchange (later simplified and abbreviated to the name Cortex) and made a substantial commitment of financial resources to realizing the Cortex vision – capitalizing the Cortex 501(c)3 non-profit with \$29 million in development funds. In 2005 the Cortex Board of Directors commissioned a master plan for district development in a 200-acre area of blighted, primarily industrial-legacy land, that was ideally located proximate and adjacent to Cortex' founding partners (Figure 1).

The redevelopment of the 200-acres has been greatly facilitated by the early recognition of the importance of the development by the City of St. Louis. The City formally established the Cortex site as a "Redevelopment District" and granted the Cortex organization the status of "Master Developer." This latter status granted Cortex the necessary powers and authority to provide tax abatements to stimulate development, use eminent domain powers (if required) to acquire property, and the ability to secure state tax credits and federal grants.

The development of Cortex may best be viewed as having occurred in two phases. The first phase, spanning 2002-2009, emphasized bioscience as the focus of the district and saw the development of Cortex I as a multi-tenant office and lab building, and the build-to-suit development of the Solae soybean R&D facility. The early mixed-use – live/work/play/learn – environment benefited from development of a previous factory building into residential condominiums and apartments. By the close of 2009, Cortex was home to 35 companies. While Cortex had started to develop some

momentum, it was felt by the Board that the speed and scale of development was falling short of their vision. As a result of this assessment, the Board voted to bring-on an experienced President and CEO, supported by 10 staff, to more rapidly advance the District's development. Notably, the President and CEO saw a strategic need to pivot the organization from solely focusing on bioscience to a broader vision of Cortex as a hub for any advanced technology and associated support services. This pivot was very much on-point and visionary in recognizing the emerging trend in "convergence" – i.e. the tendency for innovation to occur at the intersection of multiple disciplines and industries. By opening Cortex to companies not only in bioscience but in other technology spaces, such as information technology, data analytics, advanced manufacturing, logistics, materials and other sectors, opportunities for novel combinations of technologies and capabilities could be realized. The decision to embrace other sectors was especially prescient in terms of attracting companies in digital technologies, programing and advanced analytics that are proving to be central to the ongoing "digitalization of everything" movement being experienced across almost all areas of commercial growth.

Since the hiring of the professional management team in 2010 Cortex has experienced robust development momentum and growth, with 10 times the number of companies located at Cortex today than were in the district at the end of its first 8 years of operation. As noted by Cortex management, the 2010 to 2018 "Phase II" of the development has seen "multiple collaborations, development partnerships and projects advanced." Notable among these are:

A new I-64 Interchange into the district, a new MetroLink light-rail station established, a 3-acre park built, plus the Cortex Commons and 9 additional buildings have been rehabbed or newly constructed. Currently, two additional buildings are under construction. Today, nearly 2 million square feet has been developed from \$700 million of investment. While the majority (~300) of these companies are startups or individual entrepre-

neurs, we are now seeing large companies being attracted to Cortex, including: Centene, Accenture, Express Scripts, Square, AB Mauri, Boeing, Emerson, Pandora, Nestle-Purina, Mastercard and Microsoft, which just opened their newly established Midwest regional headquarters in Cortex August 2018.⁶

Today, Cortex is rebranded and named the **Cortex Innovation Community** – a name that intrinsically recognizes the interpersonal interactions that drive a healthy TBED ecosystem. Across the period spanning 2010 to today, very real momentum has been achieved and Cortex is increasingly recognized on a national stage as a pioneer in the burgeoning Innovation District movement – a movement that itself is gaining momentum, recognized as a key mechanism for advanced economic development for states, regions and individual cities.

⁶ Cortex, Organizational History. Document provided to TEconomy by Cortex management.

C. ABOUT THIS STUDY AND ANALYSIS

The success of the Cortex Innovation Community, and the ongoing promise it contains for further advanced economic development in the St. Louis region, represents a compelling case-study of importance to the region and the national economic development community.

Cortex is an exemplar among Innovation Districts and explaining what has been achieved and documenting the robust economic and functional impacts being generated, for the City of St. Louis and the St. Louis metro region is an important and necessary task. Parties both internal to St. Louis (stakeholders, regional partners, industry groups, government agencies) and external (the broader economic development community and other national and regional leaders concerned with the future development of our national, state and regional economies) need to be provided with an in-depth assessment of what Cortex has achieved and the lessons that may be learned from its successful and ongoing growth. Recognizing this need, Cortex management sought development of analysis that would document what has been achieved, quantify current economic and community impacts being generated by Cortex, outline the returns that investment in Cortex has brought to the region, and document the promise contained in the development for the future.

Cortex management approached TEconomy Partners, LLC. (TEconomy) to request a proposal of services for conducting the economic and functional impact analysis of the Innovation Community.

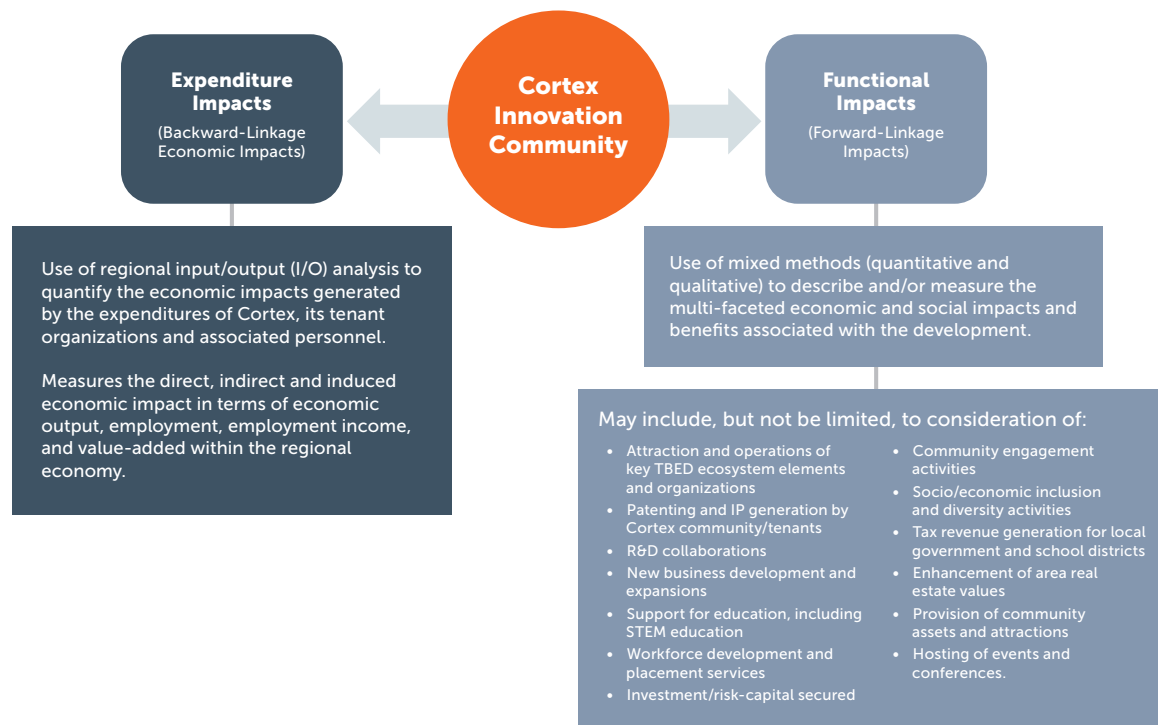
TEconomy's has a unique combination of expertise in economic impact analysis and advanced innovation-based regional economic

development. TEconomy is a leading advisor to national governments, states, regions and metro-areas in: technology-based economic development (TBED); the generation of new business development and economic growth based-upon academic research core competencies; the structuring of initiatives to advance innovation and its impacts on the economy; and, comprehensive economic development strategy development. TEconomy's principals have familiarity with Cortex and the St. Louis TBED efforts having conducted the original regional analysis for St. Louis in 2000 that helped guide early investments, as well as undertaking the five-year update report produced in 2005. TEconomy has also been working with the Brookings Institution and other leaders in the assessment and development of innovation districts throughout the U.S. and has wide-ranging experience in conducting in-depth economic and functional impact assessments for a broad range of technology-focused organizations, developments and programs including, for example: the Association of University Research Parks; BIO; PhRMA; the American Physical Society; the Human Genome Project, and the United States Department of Agriculture. TEconomy Partners was formerly known as the Battelle Technology Partnership Practice, and transitioned to become an independent company in 2015.

D. METHODOLOGY

In conducting impact analysis TEconomy addresses impacts across two principal dimensions: (1) the impact of development associated expenditures (which are also termed “backward linkage economic impacts” by regional economists); and (2) functional impacts (aka “forward linkage impacts”). The latter category of functional impacts captures the mission-oriented activities of a development in terms of the effects on industries, people, place, society and the broader socio-economic environment (Figure 2).

Figure 2: The Structure of Impacts Evaluated for the Cortex Innovation Community.



To quantify the **expenditure economic impacts** of Cortex, and the enterprises and institutions located within Cortex, TEconomy uses IMPLAN-based Input/Output (I/O) analysis to measure the direct, indirect, and induced economic impacts of Cortex on the key economic geography of the 15 county (MO and IL) St. Louis MSA⁷. IMPLAN is one of the most widely used I/O models in the nation and can be used to analyze the economic impacts of companies, projects, developments or entire industries. An input-output analysis examines the relationships among businesses and final consumers based on project specific data. The input to this I/O analysis was construction and operational data for Cortex and the employment levels by sector across organizations, businesses and institutions with a footprint within the Cortex Innovation Community. Inputs were analyzed using the IMPLAN models to derive measures of direct, indi-

⁷ For the purposes of this analysis, the St. Louis Region is synonymous with the St. Louis Metropolitan Statistical Area (MSA) which consists of both Missouri regions (St. Louis City, and Franklin, Jefferson, Lincoln, St. Charles, St. Louis, and Warren counties) and Illinois regions (Bond, Calhoun, Clinton, Jersey, Macoupin, Madison, Monroe, and St. Clair counties).

Regional Input/Output (I/O) Analysis

Input/output (I/O) analysis models the interrelationships and financial transactions between economic sectors. Input-output multipliers are based on the flow of commodities between industries, consumers and institutions in a state or regional economy. The IMPLAN I/O model is the most widely used model in the nation and is based on the U.S. Bureau of Economic Analysis national accounts data, supplemented with state level employment data from the U.S. Bureau of Labor Statistics and other economic data from the U.S. Bureau of the Census. The analysis calculates three categories of impacts, which sum to total impact:

- **Direct Impacts** – the specific impact of the direct expenditures of Cortex and the organizations based within the Innovation Community.
- **Indirect Impacts** – the impact of suppliers to Cortex and organizations based within the Innovation Community
- **Induced Impacts** – the additional economic impact of the spending of employees and supplier employees
- **Total Impact** = the sum of the three above impact categories.

In effect, the input-output analysis models the “ripple effect” (also known as the multiplier effect) that originates from Cortex-associated expenditures in the St. Louis regional economy.

The IMPLAN input/output model derives estimates for four types of impacts:

- **Output** (also known as production, sales, or business volume) is the total value of the goods and services produced in the economy.
- **Employment** is the total number of jobs created and includes the direct employment at organizational operations within the Cortex boundaries.
- **Labor Income** is the total amount of income, including salaries, wages and benefits, received by employees and others in the Cortex-related supply-chain.
- **Government Revenues** includes estimates of revenues generated for federal and state/local governments through the economic activity

rect, and induced impacts for employment, personal income, output, and tax revenue measures for Cortex as it exists today.

As noted by the Cortex Innovation Community:

The goal of Cortex is to establish St. Louis as a nationally and internationally recognized technology hub. Our objectives are to (1) increase the City’s tax base to support essential services, (2) attract and create tech-based jobs, and (3) maximize inclusivity in our work. To achieve our objectives, Cortex engages in “innovation engineering.” We have evolved our business plan over time to focus on building an innovation community, and not just an urban business park. We developed and are implementing a new mixed-use masterplan to create a live-work-play-learn, car-optional community of innovators. We changed our name to the Cortex Innovation Community. We expanded Cortex to include all technologies – not just bioscience. We now have a dual focus on growing our own startup companies and not just recruiting established technology companies. We actively engage and invest in physical placemaking public realm improvements. And we facilitate and curate a broad range of innovation programing that supports our innovation companies and inclusion objectives.⁸

The above goals and objectives for Cortex are being met through what are called “functional impacts” – these are the impacts generated through the mission-based activities of the Cortex Innovation Community. Figure 3 illustrates the structure of these and the highly diverse range of impacts being generated for the City of St. Louis and the St. Louis region. Functional impacts are examined and discussed in Chapter III of this report, with a mix of quantitative and qualitative methods used in their analysis (Table 1).

8 Cortex, Organizational History. Document provided to TEconomy by Cortex management.

Figure 3: Functional Impacts of Cortex

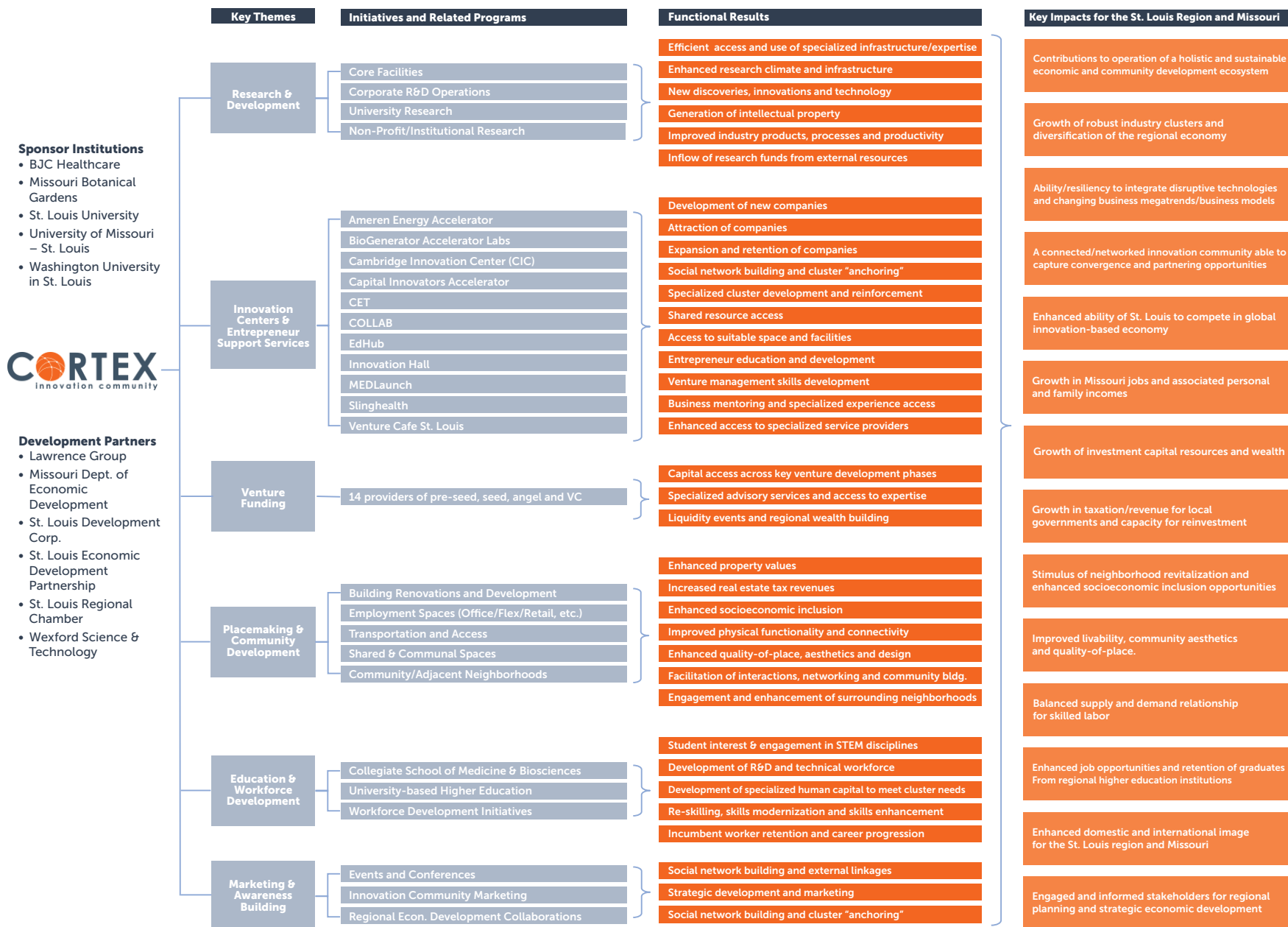


Table 1: Categories of Functional Impact Associated with the Cortex Innovation Community

Functional Impact Category	Benefit for the City of St. Louis and the St. Louis region
Contribution to the operation of a holistic and sustainable economic and community development ecosystem	Innovation districts (mixed-use, high-density developments geared to appeal to technology companies and their workforce) have become a desirable locational asset for regions seeking to advance technology-based economic development. The live/work/play/learn characteristics provide place-based ecosystem enhancement to meet the preferences of new and expanding technology enterprises.
Growth of robust industry clusters and diversification of the regional economy	Cortex facilitates companies operating in close proximity in co-working, incubator and accelerator space to encourage inter-firm synergies and technology convergence opportunities. The development contains specialized lab space and access to specialized core facilities to meet the needs of cluster industries.
Ability/resilience to integrate disruptive technologies and changing business megatrends/business models	Chapter IV of this report highlights the emerging forces related to convergence, multiple disruptive technologies and new business models and megatrends. The ability to leverage these forces for positive economic growth benefits from locational proximity of R&D performing institutions, research assets and innovative businesses.
A connected/networked innovation community able to capture convergence and partnering opportunities	Placemaking matters greatly because competitiveness in the global economy, in part, requires creative interactions between individuals, including informal interactions. For this to occur, proximity and spatial design matter. Facilities and infrastructure at Cortex have been designed to specifically encourage informal and formal gatherings and networking within and across sectors.
Enhanced ability of St. Louis to compete in a global innovation-based economy	The cost structures associated with operating in the U.S. mean that our economy cannot advance on simple low-cost production models but rather advances on an ability to innovate, create new products and entire new business segments via R&D leadership. Cortex is an environment purpose designed to meet the needs of R&D based innovators and the work-environment preferences of a technology workforce.
Growth in Missouri jobs and associated personal and family incomes	Cortex has become home to a diverse range of companies. While some of these are internal relocations of companies within the region, the majority represent new entrepreneurial enterprises and thus a net gain for the region in terms of employment. Technology-based enterprises typically employ workers at an average wage level considerably above average private sector wage levels.
Growth of investment capital resources and wealth	Cortex has become a go-to location for regional operations of venture capital and other risk-capital finance companies to locate their offices. This is beneficial for proximate access to business deals. And Cortex companies have attracted investments from 113 investment organizations.
Growth in taxation/revenue for local governments and capacity for reinvestment	With significant TIF financing, the development of Cortex has been designed around building value in real-estate that will generate significant tax payments in the future as TIFs expire. This is already occurring. In addition, as discussed herein, evidence points to strong Cortex impacts on surrounding area property values (increasing the taxable base), and Earnings and Activity Taxes (EATs) are also being generated through payroll and earned income taxes, utility taxes, restaurant gross receipt taxes and local sales taxes associated with Cortex operations.
Stimulus of neighborhood revitalization and enhanced socioeconomic inclusion opportunities	Chapter II of this report, using quantitative real estate analysis, demonstrates that the zip codes containing Cortex have significantly outperformed other areas of St. Louis in terms of increasing median property values. Chapter III highlights multiple activities of Cortex and Cortex-based organizations in terms of seeking to enhance inclusion and social mobility via access to Cortex employment and entrepreneurship opportunities.

Functional Impact Category	Benefit for the City of St. Louis and the St. Louis region
Improved livability, community aesthetics and quality-of-place	Cortex occupies a previously blighted area of the City that was of considerable concern to major adjacent institutions including SLU, WUSTL and BJC prior to its redevelopment. Cortex has now become a signature regional feature that these organizations use to help attract recruits, and significant improvements to property and infrastructure in the district have created a dynamic and attractive tech environment, well served by modern transportation infrastructure.
Balanced supply and demand relationship for skilled labor. And, enhanced job opportunities and retention of graduates from regional higher education institutions	The proximity of Cortex to major research universities and a new STEM school, provides the district and its tenants with opportunities to engage in workforce development discussions with major institutions, to participate in curriculum development, and assist in education and skills development via internships and other mentoring opportunities.
Enhanced domestic and international image for the St. Louis region and Missouri	Cortex is becoming well-recognized in technology-based economic development circles as a robust example of innovation district development and the purposeful structuring of a complete technology-based economic development (TBED) ecosystem. It is a signature asset for the region, showcasing St. Louis' emergence as an expanding tech hub and home to innovation in advanced industries. Both domestic and international companies have located operations into Cortex.
Engaged and informed stakeholders for regional planning and strategic economic development	Cortex is more than a single management/development organization, rather it is a coming together of major regional public and private sector stakeholders, institutional investors, economic development agencies and other key parties to form a strategic and highly networked development enterprise and associated ecosystem.

II. THE ECONOMIC IMPACTS OF CORTEX

The Employment, Economic, and Financial Impacts of the Innovation Community on the St. Louis Region

The Cortex Innovation Community represents a unique and dynamic mix of organizations and sectors that represent “innovation” across numerous dimensions—in research and development, in operational structure, in organizational mission, in supporting emerging firms, and ultimately in work-life balance. Cortex is home to core operations of higher education and health care, research operations for Fortune 500 companies, emerging bioscience and IT firms, and a variety of other firms that are interwoven into the fabric of the St. Louis regional economy.

The following section provides a quantitative perspective on what Cortex is, how it has developed and grown, and what are the economic impacts associated with its development and operation as of 2018. Within these impacts three types of economic and financial effects are examined: 1) expenditure impacts (typically referred to as a project or program’s economic impact); 2) tax base/TIF-related impacts; and 3) impacts on real estate values in and surrounding the Cortex Innovation Community.

A. OPERATIONS AND EMPLOYMENT PROFILE OF CORTEX INNOVATION COMMUNITY

The exact number of companies and employment within the Cortex Innovation Community continues to change and grow as new companies and new development occur within the Community.

As of the end of 2018, 369 companies or organizational offices called Cortex home. These 369 entities are estimated to account for 5,780 jobs (full and part-time). This employment is housed across multi-tenant, innovation-based locations, new university and health care-related facilities, or existing and new corporate locations of Community members (Table 2). The largest single facility, in terms of employment, is the BJC@The Commons facility housing key administrative functions for BJC HealthCare, which also makes BJC currently the largest single employer within the Community.

Table 2: Employment by Key Cortex Locations

Cortex Location	Number of Companies	Current Employment
BJC @ The Commons	2	1,065
CIC @ 4240 (4240 Duncan)	77	1,005
CIC @ CET (20 S. Sarah)	157	502
Cortex 1 (4320 Forest Park)	8	224
BioGenerator	52	212
CIC @ 4220 (4220 Duncan)	54	196
Distinct Innovation Community Members (Corp Sites)	19	2,576
Totals	369	5,780

Source: TEconomy Partners analysis.

A large and varied set of research, commercialization, technical and administrative functions of Washington University also are located within the Community, spread among a number of locations (including Cortex 1) and providing numerous bridges for faculty and staff to the community of innovation within Cortex. The unique multi-tenant innovation and co-working spaces created by Cambridge Innovation Center (CIC) and BioGenerator currently house more than 1,900 employees, with new employment being added into these spaces on a continual basis. Within these facilities, corporate operations range from innovation-related offices of Fortune 500 firms such as Boeing, Microsoft, and Cardinal Health to unique R&D operations of AB Mauri, bioMerieux, and numerous emerging technology companies. Other significant innovation and service employers operating within Cortex include Square, DuPont Nutrition & Health, Accenture, Aon, PennyMac, Stereotaxis, and Centene. As part of the broader live/work/play environment that Cortex is working to establish the Community is also home to nearly 300 employees of IKEA and more than 100 restaurant jobs. The current 5,780 jobs within Cortex are connected to non-profit education and health care, government, and industrial sectors ranging from bioscience to aerospace, information technology to food products—with a common thread of innovation, research, development, and corporate support. Table 3 characterizes the Cortex employment by key sectors.

Table 3: Employment by Key Cortex Sectors and Company Types

Cortex Industry Sector/Company Type	Current Employment
Innovation Centers and Cortex Operations Staff	108
Other Non-Profit (including BJC)	1,086
Software/IT/Media Development	948
Higher Education	813
Management Consulting/Other Business Support Firms	752
Insurance, Financial, and Real Estate Firms	555
Bioscience R&D	521
Retail, Restaurants, and Other Amenities	448
Food Processing R&D	328
Scientific/Engineering/Environmental Consultants	87
Individual Entrepreneurs in Coworking Space NEC*	87
Government Agencies	47
Total	5,780

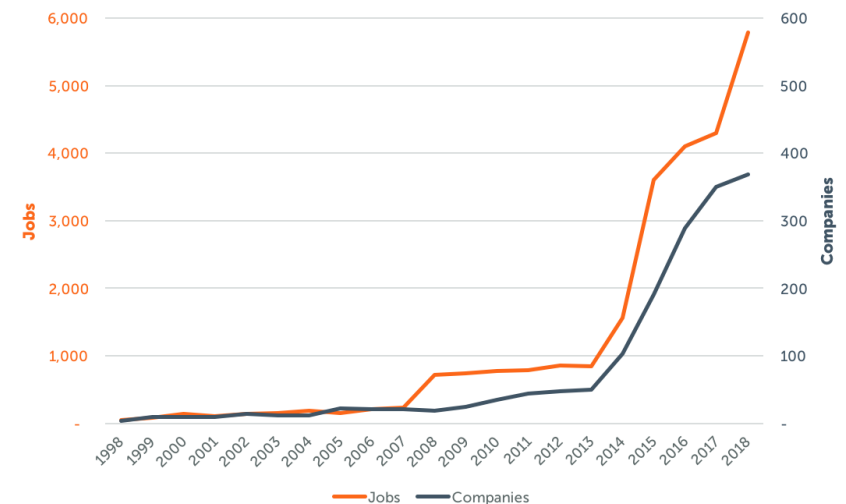
Source: TEconomy Partners analysis. *NEC = Not Elsewhere Classified

A key consideration in assessing the current size of the Cortex Innovation Community is, like every innovation district or research park, patience is required before seeing significant employment and impacts. Infrastructure needs to be developed and facilities need to be built and/or redeveloped. During this continual (and continuing) process, the identity and image of what the Community wants to be is fostered and nurtured to become what it is today, and what it will be tomorrow. There are no overnight successes. This process, dynamic, and current level of success is no more apparent than by examining the number of companies and the level of employment

within the Cortex Innovation Community from the days prior to its establishment through 2018 as shown in Figure 4.

Through the first five years (2002-2007) limited new growth occurs in the Community, with most of the employment tied to existing organizations. The next five years (2008-2013) begin to see the supporting infrastructure emerge and new employment being added into the Community. The most recent five-year period (2014-2018) reflects a significant level of growth, building on the assets and inertia developed in the first ten years, with additional demand driven by the Cortex "identity" as an innovative community that both new and existing firms and individual entrepreneurs want to be a part of.

Figure 4. Growth in Companies and Employment at Cortex



Source: TEconomy Partners analysis of Cortex employment data.

B. EXPENDITURE-BASED ECONOMIC IMPACT ANALYSIS

While the current employment level of 5,780 provides a substantial direct impact to the St. Louis regional economy, this level of employment also generates and supports significant economic value throughout the region through the purchases of member companies and the spending of the Cortex Innovation Community's workers.

As described in the Methodology (Section 1.B), input/output analysis, via a St. Louis MSA regional IMPLAN model is used to measure and assess both the direct impacts of these 5,780 jobs, but also the economic ripple effects throughout the MSA.

The unique structure and context of the Cortex Innovation Community requires a specific approach to developing these impacts in a rationale, and perhaps conservative manner. The approach used in measuring these broader economic impacts is termed an “analysis-by-parts” analysis—treating the individual operations within Cortex based on what is performed within Cortex, not necessarily what the broader company's operations might represent. For example, Boeing's operations within Cortex are classified as management/technical consulting and investing as opposed to simply aerospace manufacturing and DuPont Nutrition & Health (formerly Solae) is classified as an R&D operation, not a soybean processing operation. Similarly, the operations within BJC @ The Commons is classified as administrative/billing/accounting versus part of the hospital sector. This approach models a much closer estimation of the impact of the activities within the Cortex Innovation Community, as most of the operations within Cortex are research and development entities, software/IT firms, and other administrative/business-support functions. This distinction is important as laboratory/office-type functions require different inputs and have different employment and economic multipliers than major manufacturing sectors or even hospitals.

In total the direct employment (5,780 jobs) within the Cortex Innovation Community is estimated to have produced more than \$1 billion in output in 2018 (Table 4). These direct jobs are also estimated to pay \$450 million in wages and benefits. Considering the differential tax treatment of non-profit entities, the companies within the Cortex Innovation Community are still estimated to pay more than \$24 million in state/local tax revenue, including employment-related taxes, on an annual basis.

The broader regional economic impact, as included in additional indirect and induced impacts, generate an additional 7,372 jobs in the St. Louis regional economy, for a **total regional employment impact of 13,152 jobs**. This yields a 2018 employment multiplier of 2.28—for every 1 Cortex direct job another 1.28 jobs are generated in the St. Louis MSA.

Table 4: Economic Impact of Cortex Innovation Community, 2018 (\$M)

Impact Type	Employment	Labor Income	Output	State/Local Tax Revenue	Federal Tax Revenue
Direct Impact	5,780	\$449.8	\$1,019.7	\$24.4	\$94.9
Indirect Impact	2,895	\$178.7	\$472.4	\$13.4	\$39.7
Induced Impact	4,477	\$211.3	\$640.6	\$31.9	\$50.8
Total Impacts	13,152	\$839.8	\$2,132.7	\$69.6	\$185.4
Multiplier	2.28	1.87	2.09		

Source: TEconomy Partners analysis; St. Louis MSA (15 Counties) IMPLAN model.

From an output perspective, **the Cortex Innovation Community generates and supports a total economic impact of more than \$2.1 billion across the St. Louis region**—for every \$1 in Cortex output an additional \$1.09 in output is generated by other regional firms for an output multiplier of 2.09. These direct, indirect, and induced

impacts are estimated to generate nearly \$70 million in state/local tax revenues and \$185.4 million in federal tax revenues. These tax revenues, in turn, help fund via tax increment financing, the asset and infrastructure improvements required to support Cortex development.

C. IMPACT ON THE TAX BASE/TIF

As with most large-scale urban economic development placemaking initiatives, Cortex has been able to leverage and deploy a series of public subsidy funding mechanisms.

Such public mechanisms are particularly important when directed towards encouraging redevelopment within economically disadvantaged or physically blighted urban areas that without subsidy would struggle to achieve private sector investment. Public sector funding mechanisms help to seed infrastructure and other environmental improvements that enhance the attractiveness for private investment and may be deployed as incentives to enhance the financial viability of commercial projects, reduce the risk of projects, or defer the payment of taxes until revenue-generation can sustainably occur.

The Cortex Innovation Community has been able to utilize a broad suite of public funding mechanisms from various government entities including: the City of St. Louis; regional planning bodies; the State of Missouri and federal sources. The foresight of government entities and legislators in developing public finance programs and associated incentives has been crucial to innovation district development in urban America. Government has been responsive by providing the finance tools required for Cortex to spark successful district development. Key programs available are shown in Table 5.

Tax increment financing is a financial tool that has seen widespread use by local governments to promote economic development within a specifically designated TIF district, and it has been a very important component of the financing mix in the development of Cortex. As noted by the Government Finance Officers Association⁹, the TIF process splits tax revenue generated from properties within the TIF district into two components:

- **Base revenues** – *This is the amount available before the TIF district is established; base revenues are shared among a mix of local governments that have the power to assess property taxes: schools, cities, counties, and special districts.*
- **Incremental revenues** – *These new revenues in excess of the base revenues are generated by development projects. These dollars are allocated to the government that sponsors the TIF project. Although some states permit counties to use tax increment financing, in most cases the sponsoring government is a municipality.*

⁹ Nicholas Greifer. 2007 "An Elected Official's Guide to Tax Increment Financing." Government Finance Officers Association

Table 5: Public Subsidy Funding Mechanisms Available to Cortex Innovation Community Development

Provider	Program or Incentive
City of St. Louis	Tax increment financing (TIF)
City of St. Louis	Land Reutilization Authority facility lease
Regional	Metropolitan Sewer District EPA consent decree grant
Regional	East West Gateway planning grant
State of Missouri	Tax increment financing (TIF)
State of Missouri	Development Finance Board donation tax credits (50%)
State of Missouri	Chapter 353 Urban Redevelopment District (RE abatement)
State of Missouri	Innovation Center grants – annual for operations
State of Missouri	Incubator Tax Credit Program (50%) – annual for capital projects
State of Missouri	Building Entrepreneurial Capacity Program grants
State of Missouri	Development Tax Credit program
State & Federal	Historic Tax Credits
Federal	New Market Tax Credits
Federal	Economic Development Administration grant
Federal	TIGER transportation grant to build light rail MetroLink station

As the Government Finance Officers Association indicates, “by giving exclusive use of incremental revenues to the sponsoring government, the successful tax increment financing process generates a revenue stream to underwrite projects within the TIF district and to provide

development subsidies to encourage growth.”¹⁰ Cortex development activity is structured as a “Super TIF” that comprises 12 sub-districts. Under the agreement with the City and State, Cortex management have been able to “activate” each sub-district as the development progresses and as sub-district begins its development. Cortex operates under a 2014 TIF master plan that is regularly updated as new development occurs and future developments are planned for. The master plan tracks TIF revenue generation and includes calculation of two primary categories of tax revenues generated:

- Real estate taxes
- Earnings and Activity Taxes (EATs) which include, for example, payroll and earned income taxes associated with persons working or residing within the district, utility taxes, restaurant gross receipt taxes and local sales taxes.

The most recent projections from the Cortex master plan model are shown on Table 6, broken out to show the revenues projected to be generated for Cortex-impacted taxing jurisdictions (and specific government programs to which revenues are allocated) after TIF project allocations. The projections are shown in five year increments, beginning with the base year of 2014 and running through 2043 (the 30th year). For real estate taxes, the increment over the base year when the TIF was approved is what goes to the TIF; the original base amount, plus commercial surcharge, goes to the public taxing bodies. EATs are split 50/50 between the TIF and public bodies. These data clearly show the large scale revenues being generated through the successful ongoing development of the Cortex Innovation Community, and the substantial future revenues to be anticipated as the district proceeds to plan. Over the 30 year period of TIF revenue projections, it is anticipated that more than \$775 million in revenues will be generated through Cortex development.

¹⁰ Nicholas Greifer. “An Elected Official’s Guide to Tax Increment Financing.” Government Finance Officers Association. Accessed online at: <https://www.gfoa.org/sites/default/files/EOGTIF.pdf>

Table 6: TIF Revenue Projections (2014 through 2043)

Taxing Jurisdiction	2014 – 2018 (5 Year)	2019 – 2023 (10 Year)	2024 – 2028 (15 Year)	2029 – 2033 (20 Year)	2034 – 2038 (25 Year)	2039 – 2043 (30 Year)
State of Missouri	\$12,940,000	\$39,770,000	\$74,230,000	\$110,480,000	\$148,590,000	\$188,650,000
St. Louis City	\$11,860,000	\$51,790,000	\$115,260,000	\$189,770,000	\$276,620,000	\$387,610,000
Community College	\$160,000	\$500,000	\$990,000	\$1,500,000	\$2,480,000	\$5,340,000
MSD	\$100,000	\$260,000	\$480,000	\$700,000	\$1,250,000	\$3,110,000
St. Louis City Schools	\$5,560,000	\$9,790,000	\$22,550,000	\$35,800,000	\$60,630,000	\$130,600,000
St. Louis Zoo/Museum District	\$200,000	\$640,000	\$1,270,000	\$1,920,000	\$3,170,000	\$6,820,000
St. Louis Public Library	\$410,000	\$1,300,000	\$2,580,000	\$3,900,000	\$6,460,000	\$13,910,000
Sheltered Workshop	\$110,000	\$350,000	\$690,000	\$1,040,000	\$1,720,000	\$3,720,000
Community Mental Health	\$70,000	\$210,000	\$420,000	\$630,000	\$1,040,000	\$2,240,000
Children's Service Fund	\$140,000	\$440,000	\$870,000	\$1,320,000	\$2,190,000	\$4,720,000
Senior Services	\$50,000	\$430,000	\$1,070,000	\$1,790,000	\$2,560,000	\$3,390,000
Metro parks	\$570,000	\$1,030,000	\$1,640,000	\$2,280,000	\$2,950,000	\$3,650,000
Metrolink	\$1,530,000	\$4,680,000	\$8,710,000	\$12,950,000	\$17,400,000	\$22,080,000
Cumulative Total	\$33,700,000	\$111,190,000	\$230,760,000	\$364,080,000	\$527,060,000	\$775,840,000

Over the 30 year TIF period the cumulative TIF revenues generate an annual average of \$12.92 million for the City of St. Louis. This equates to an average of \$64,602 in TIF revenues for the City per acre per year from the Cortex Innovation Community's 200 acres. These Cortex TIF revenues per acre are considerably larger than the average tax revenues generated per acre within the City currently. For FY2017 the City of St. Louis reports¹¹ that \$590.8 million in tax revenues were collected. With 23,808 acres of taxable property in the City¹², this equates to an average of \$24,815 in tax revenues

generated per average taxable acre in the City. The Cortex average of \$64,602 per acre per year exceeds the City wide average by a factor of 2.6x. The TIF revenues for the St. Louis Public Schools generated by Cortex are also significantly higher than the average per acre tax revenues generated in the City for the schools (\$21,767 per Cortex acre, versus an average of \$11,529 per acre for the rest of the City¹³).

11 Office of the Comptroller. 2017 Comprehensive Annual Financial Report. Fiscal year Ended June 30. City of St. Louis.

12 Scott Ogilvie. 2018. The Non-Profit Paradox. 40% of Real Estate in St. Louis is Government Owned or Tax Exempt. NextSTL. Accessed online at: <https://nextstl.com/2018/11/the-non-profit-paradox-40-of-real-estate-in-st-louis-is-government-owned-or-tax-exempt/>

13 For the year ending June 30, 2017 St. Louis Public Schools collected \$274.5 million in tax revenues. Source: Comprehensive Financial Report, St. Louis Public Schools. Accessed online at: <https://www.slps.org/cms/lib/MO01001157/Centricity/Domain/10/St.%20Louis%20Public%20Schools%202017%20cafr%20Final.pdf>

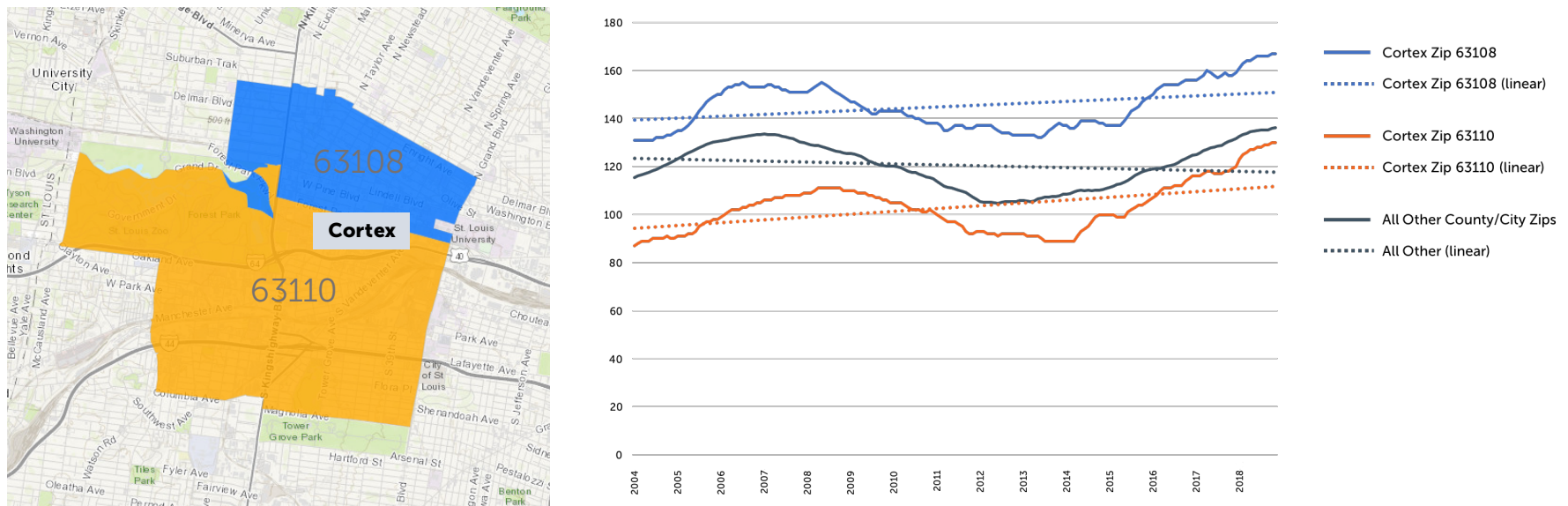
D. VALUE OF REAL ESTATE AND SURROUNDING AREA IMPACTS

As the Cortex Innovation Community has evolved into a successful innovation district and an important employment hub for the St. Louis region, it can be hypothesized that the development is helping to boost real property values in the district and in neighborhoods adjacent to the district.

To test whether it is the case that increased real property values are being realized, TEconomy performed analysis of two separate datasets covering residential real estate values. Zillow allows for the download of several datasets comprising refined data at the zip code level nationally. Monthly Zillow time-series data were accessed from January 2004 onwards (with the last available data value being November 2018) for the median value per square foot of residential real estate in both the City of St. Louis and St. Louis County. The

data were graphed for the principal zip codes containing the Cortex development (63108 and 63110) and compared to the average value for the data across the rest of the City of St. Louis and St. Louis County combined. These data show a distinct difference in the trendline of property values in the Cortex zip, with the Cortex zip outperforming the City/County region combined zip overall (Figure 5). Fitting linear trend lines to these data indicate that residential property values for the City of St. Louis and St. Louis County overall demonstrated a

Figure 5: Time Series Analysis of Residential Per Sq. Ft. Property Values for Zip Codes Containing Cortex (1/2004 through 11/2018)¹⁰

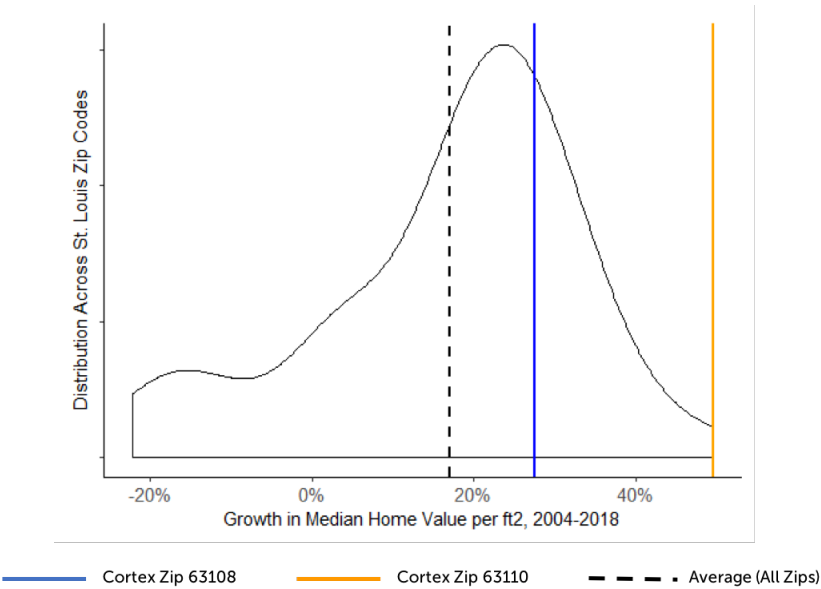


14 Data Source: Data acquired from Zillow.com/data on 1/3/2019. Data for median value per square foot for residential real estate, by zip code.

moderate downward trend over the time period evaluated, whereas both Cortex zip codes experienced increasing property values.

Figure 6 provides another perspective on these data, presenting a kernel density (k-density) distribution of growth in median home value per square foot for 2004-2018 across St. Louis area zip codes. The black dashed vertical line shows the position of the average growth in value across all City and County zips. The blue vertical line is the growth position for the Cortex zip code 63108 and orange is zip 63110. It is evident that both the Cortex-containing zip codes have experienced growth above the average for the City of St Louis and St. Louis County region. Moreover, the Cortex zip 63110 achieved the highest growth rate of any regional zip over the 2004-2018 period (49.4%).

Figure 6: Kernel Density Analysis of Growth in Median Home Value Per Square Foot for St. Louis City and County Zip Codes (2004-2018)



15 Source: U.S. Census Bureau, 2013-2017 American Community Survey 5-Year Estimates. Accessed online at: <https://factfinder.census.gov>

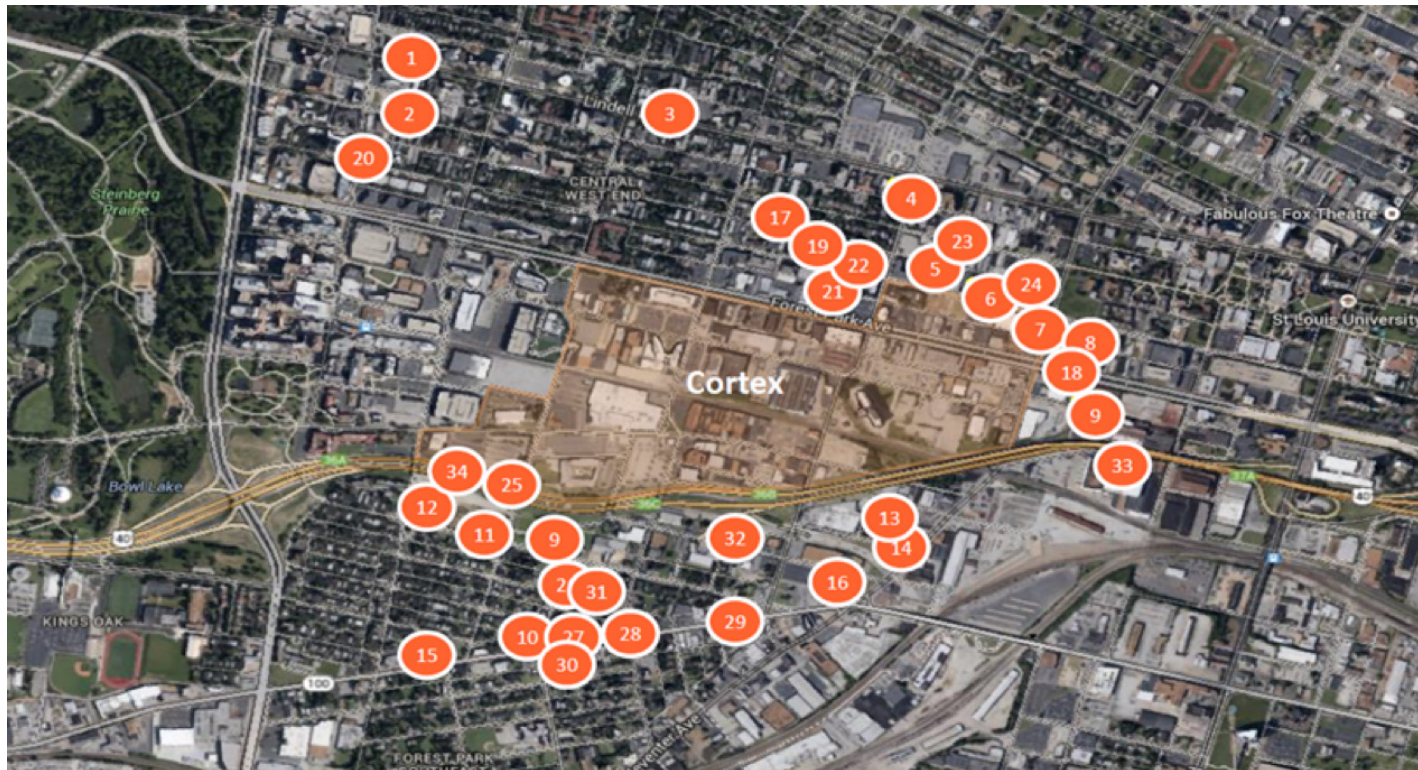
It should be noted that Zillow’s data has some gaps for zip codes where very limited sales of property occurred, but generally the dataset is quite robust. To check if the trends are observable in an alternative dataset, TEconomy also analyzed the U.S. Bureau of the Census’ American Community Survey (ACS) data which reports survey-based data at the census tract level. Comparing the main Cortex Census Tract (1186) to the St. Louis MSA for residential real estate (with ACS data reported back to 2010) generally confirms the finding from the Zillow-based analysis – that is that the growth in the value of residential real estate in the area of Cortex has exceeded the growth rate for residential real property in the MSA overall (Table 7).

Table 7: Median Value for Residential Real Estate (Owner Occupied) for Cortex Main Census Tract (1186) and the St. Louis MSA¹⁵

Spatial Area	2010	2014	2017	CAGR 2010-17	CAGR 2014-17
Cortex main (1186)	\$163,200	\$166,900	\$179,300	1.4%	2.4%
St. Louis MSA	\$159,800	\$156,900	\$162,600	0.2%	1.2%

Increases in residential real estate values provide one measure of the induced impact of Cortex on neighborhoods adjacent to Cortex. Another perspective on property and development impacts can be found through examination of privately funded developments (commercial, retail, multi-family residential and other property development) that have occurred adjacent to Cortex as the Innovation Community achieved momentum. Figure 7 illustrates many of the major property developments that have occurred adjacent to Cortex in parallel with the Innovation Community’s growth. IN total, more than \$950 million in investment has been made in these in Cortex-adjacent developments.

Figure 7: Thirty Four Privately Funded Development Projects (Completed, Under Construction and Proposed) Adjacent to Cortex. Combined Development Investment of > \$950 million.



Among these adjacent developments are large-scale projects geared to expanding upon and leveraging Cortex for economic development. A prime example of this is City Foundry, a mixed-use development project (labeled number 9) on Figure 7, which is under construction, with two phases of \$135 million and \$97 million respectively. City Foundry is very much a complementary development with Cortex, slated to provide dining, food hall, retail and office space that are valuable in supporting the “live, work, play, learn” environment of the Innovation Community. Because of the increase in area employment stimulated by Cortex and the growth of major area institutions, new multi-tenant residential

developments (lofts, townhomes and apartment complexes) feature significantly in the surrounding development mix. Additionally, new hotel development is occurring to service visitors to the community, with the new Aloft hotel on the Cortex site (opening 2019) and a \$25 million Element by Westin hotel presently under construction (labelled 18 on Figure 7). What is clear is that the Cortex Innovation Community has generated a profound stimulus effect on property development and property values not only within the district, but in adjacent St. Louis neighborhoods also.

III. THE FUNCTIONAL IMPACTS OF CORTEX

Building a Holistic Innovation Ecosystem

Economic development is a discipline that works to help economies adapt and realize their full potential by expanding business output, producing wealth, and supporting the generation of quality job opportunities. A subset of the discipline is **technology-based economic development (TBED)**, an advanced form of economic development that recognizes the central role played by innovation and technological advancement in successful modern economies and the typically higher-wage jobs that are generated within technology-oriented sectors of the economy. As shown in Chapter II, the Cortex Innovation Community is home to intensive and expanding TBED activity that produces large-scale economic expansion and job-creation benefits for the City of St. Louis and the St. Louis region.

Advancing science- and technology-based economic development is not a simple task, and the impacts generated by Cortex are not occurring via serendipity – rather they are the result of formal strategies and tactics deployed by Cortex and multiple regional partner organizations. The Cortex Innovation Community has been specifically designed to provide a holistic and integrated suite of infrastructure and support services that combine to form an efficient TBED ecosystem. This ecosystem is able to support development across a full continuum from an initial R&D-based concept through to full scale-up into a profitable business venture. What Cortex provides is both the specialized environment and the community of organizations and support services needed for a high-impact TBED ecosystem to flourish. It accomplishes its economic development mission by accommodating and facilitating a comprehensive network of functional activities that create high-performance place-based TBED.

In this Chapter of the report, in-depth consideration is given to the functions performed by Cortex and facilitated within the boundaries of the Cortex Innovation Community. It is intended that the reader will gain appreciation for the complex environment that comprises a holistic TBED ecosystem and the achievements of the Cortex management, board, stakeholders and partner organizations that have coordinated and contributed to the build-out of this high-performance innovation district.

A. ACCOMMODATING AND FACILITATING A HOLISTIC TBED ECOSYSTEM

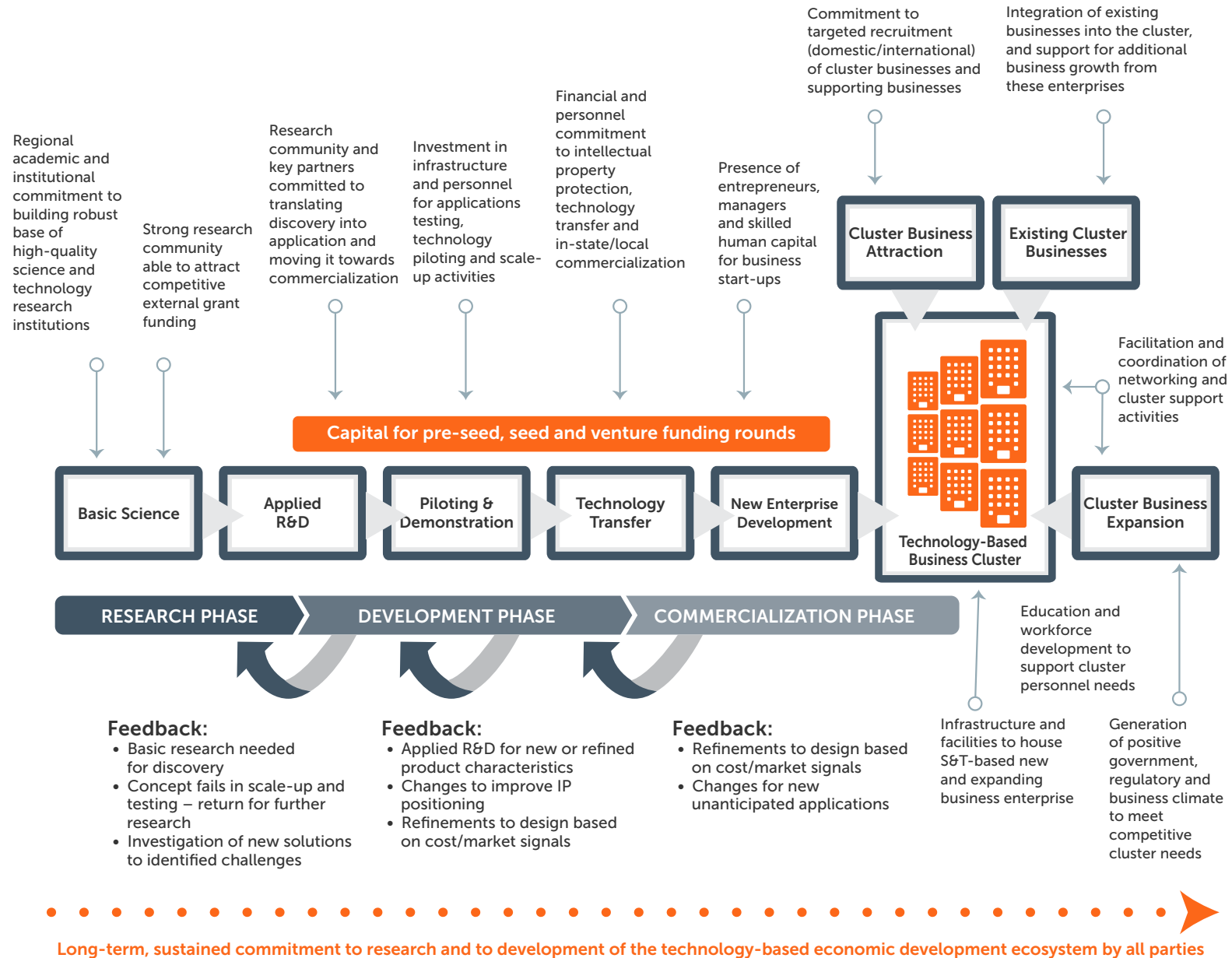
Every state, and almost every major city across the U.S. is attempting to spark TBED. There is considerable variability in their rates of success, however, and very few have seen the intensity of successful development that has been experienced at Cortex and documented in Chapter II.

This naturally leads to the question of what then has been the Cortex Innovation Community's secret to success? A simple answer to the question is that Cortex has accommodated, built and sustained a holistic and well-integrated TBED system. Cortex is not missing any critical functional elements that could cause a "system crash", and it has strategically attracted and built elements needed to reinforce identified weaknesses or gaps identified as Cortex evolved. This ecosystem is now extremely well-structured to provide a comprehensive environment in which ideas, innovations and new business ventures

can flourish – and it has a physical manifestation in a spatially defined Innovation District that is attractive to entrepreneurs, start-up business ventures, existing business operations, and the talent that is needed to power these enterprises.

Figure 8 provides a conceptual illustration of a holistic TBED ecosystem. The immediate takeaway, of course, is that it is complex. There are many elements that have to exist and appropriately interface with one another in order for the system to operate efficiently.

Figure 8: Conceptual Illustration of a Holistic Technology-Based Economic Development Ecosystem



What is extraordinary in terms of the Cortex Innovation Community is that a complete ecosystem, as illustrated in Figure 8, now exists in the 200-acre Cortex development (and immediately adjacent to it in terms of multiple university research and education operations). Cortex is home to a comprehensive system of physical environment and ecosystem-service supports necessary to sustain technology-based venture growth. In many cases this ecosystem comprises multiple providers supporting one another and overlapping in key ecosystem-service areas, providing choice and limiting the risk of the ecosystem underperforming due to any individual element weaknesses.

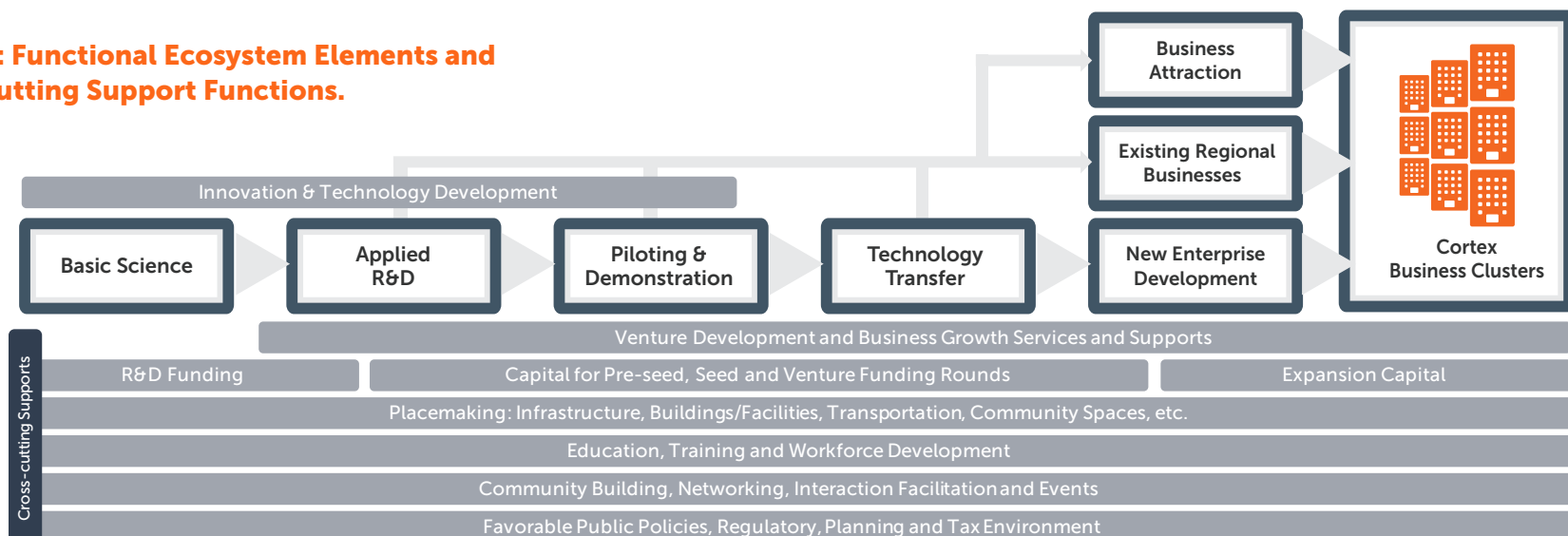
Figure 9 adapts the ecosystem graphic to show the core functional elements plus the cross-cutting support areas that are needed to maintain ecosystem operations. Key areas of functional activity include:

- Innovation and Technology Development
- Venture Development and Business Growth Services and Supports

- Capital for Pre-Seed, Seed, Venture Capital Rounds and Expansion Capital
- Placemaking Activities: Including infrastructure, Building and Facilities Development, Transportation Infrastructure and Community Spaces
- Education, Training and Workforce Development
- Community Building, Networking, Interaction Facilitation and Events
- Favorable Public Policies, Regulatory, Planning and Tax Environment

This graphic is used as the basis for illustrating the programs within the Cortex Innovation Community (or provided to it and its tenants by external organizations) – with Figures 10-12, and Figures 14-17 providing basic details on the programs supporting each Cortex ecosystem element:

Figure 9: Functional Ecosystem Elements and Cross-Cutting Support Functions.



B. CORTEX ECOSYSTEM FUNCTIONAL IMPACTS

1. Ecosystem Functions in Innovation and Technology Development

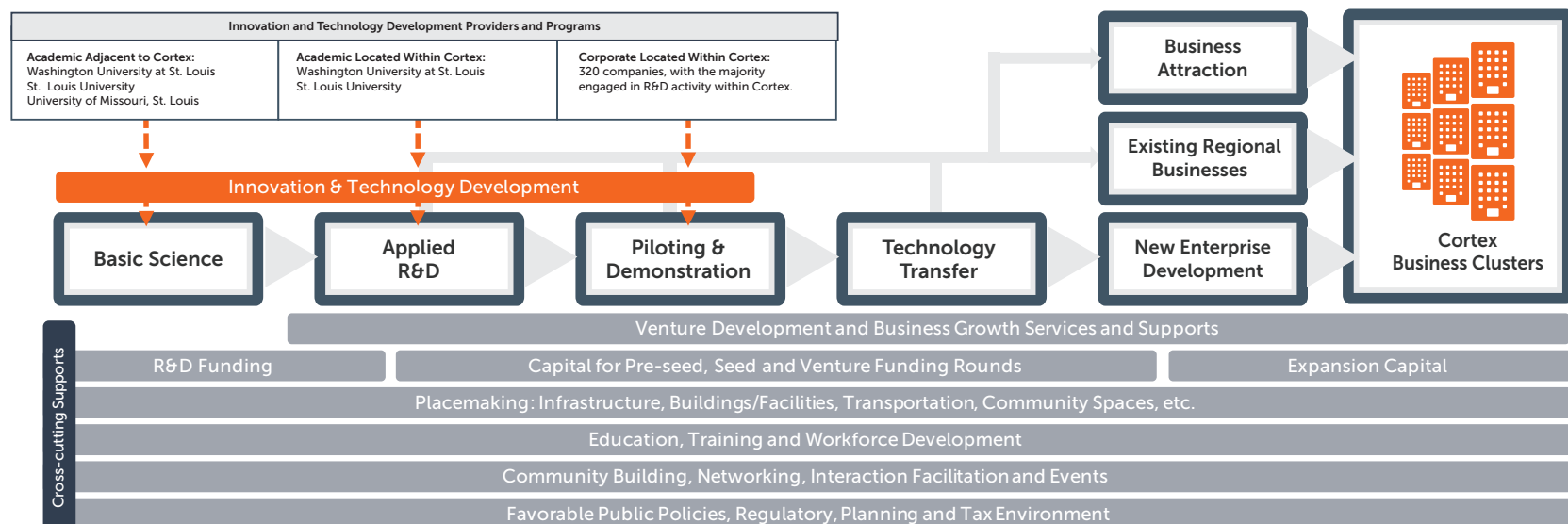
As the name implies, “innovation” is the defining characteristic of an innovation district. As noted in Chapter I, the Brookings Institution defines innovation districts as:

Dense enclaves that merge the innovation and employment potential of research-oriented anchor institutions, high-growth firms, and tech and creative start-ups in well-designed, amenity-rich residential and commercial environments. Innovation districts facilitate the creation and commercialization of new ideas and support metropolitan economies by growing jobs in ways that leverage their distinct economic attributes.

These districts build on and revalue the intrinsic qualities of cities: proximity, density, authenticity, and vibrant places.

The Cortex Innovation Community was founded by institutions deeply engaged in research. A stated goal was to “capture the commercial benefits of university and regional corporate research for St. Louis.”¹⁶ Cortex is extremely well positioned to access research at area universities, and it is also home to intensive R&D operations across a range of companies, from early-stage start-ups to major R&D ventures of global corporations (for example, the R&D operations of Solae (now DuPont Nutrition and Health)).

Figure 10: Innovation and Technology Development



The strategic location of Cortex, positioned between the Washington University in St. Louis and BJC campuses immediately to the west and St. Louis University adjacent to Cortex at the eastern boundary of the site, provide ready-access to the intense research expertise and activity contained within world class research institutions – including two academic medical center campuses.

Washington University in St. Louis has a particularly extensive research enterprise, with \$711.8 million in total research support for fiscal year 2018. This includes \$522.4 million in federal research support. The University reports more than 3,000 individual research programs underway.¹⁷ While almost all the Washington University in St. Louis research enterprise is adjacent to but not in the innovation district, the university is a key stakeholder and funder of Cortex and sees the Cortex site and its supporting ecosystem as a strategic location for university-related start-up ventures and collaborative research activities with industry and other research institutions. The intensive expertise in biomedical research and the academic medical center complex at Washington University in St. Louis is supported by the presence of Barnes-Jewish Hospital in Saint Louis (which is ranked 11th in the U.S. News “Best Hospitals Honor Roll”). The hospital system works with the University in basic through applied/clinical research.¹⁸

St. Louis University is on-the-rise as a research university, working through a five year plan to double its research funding to \$100 million plus. The expansion of research at SLU is being helped by the generous gift of \$50 million towards improving the University research environment provided by philanthropists, Dr. Jeanne and Rex Sinquefeld. SLU is using part of this funding to create the Saint Louis University Research Institute designed to serve as the focal point for growth in the University’s research and scholarship.

Universities step-up to the plate as active participants and early risk takers in Cortex.

Beyond their role as innovation engines and educators for the region the universities have played a critically important role not only in being founding partners in the formation of Cortex but also as key investors, guarantors and early tenants for Cortex developments. The universities took financial risk, leveraging their high credit status, providing rent guarantees, and boosting occupancy in Cortex buildings as an early tenant to help seed development.

The engagement is acknowledged by the universities as now paying off. A previously blighted area on their doorsteps is now a dynamic and growing live/work/play/learn environment, and positive effects are rippling into surrounding neighborhoods. The profile of Cortex as a leading example among national innovation districts is helping with faculty recruitment (especially with faculty who have interest in commercialization of research). As a hub for tech employment, Cortex has become a site for valuable student internships and is helping to retain the high quality graduates of regional universities by providing job opportunities in the dynamic, high-paying technology sectors.

The opening of the Metrolink station at Cortex also greatly improves direct access to the University of Missouri-St. Louis (UMSL) and its research assets and expertise. With 9,487 FTE students for FY2019, UMSL is an important public higher education provider for the region and UMSL anticipates total research funding for FY2019 of over \$29 million.¹⁹

The Cortex Innovation community is now home to 369 institutions, firms, and entrepreneurs, ranging from single-person start-up ventures, through fast-growing mid-size ventures, and on to operations

¹⁷ Washington University in St. Louis. “University Facts: Research.” Accessed online at: <https://wustl.edu/about/university-facts/>

¹⁸ U.S. News & World Report. Best Hospitals. Barnes-Jewish Hospital. <https://health.usnews.com/best-hospitals/area/mo/barnes-jewish-hospital-washington-university-6630930>

¹⁹ <https://www.umssystem.edu/media/fa/budget/budgetbook.pdf>

of large companies (in terms of R&D operations, regional HQ's, and marketing and sales operations).

Many of these operations engage in some form of technology R&D or business practice innovation activity. Beyond the major corporate operations in the District, TEconomy estimates that approximately 120 of the 369 organizations currently residing in Cortex are emerging research and innovation-based ventures. Cortex has been particularly successful at developing physical space that allows the diversity of commercial operations at Cortex to interact with one another. The majority of Cortex-based companies are co-located in a series of incubator/accelerator-oriented developments – spread across a small cluster of buildings (such as 4240 and 4220 Duncan and Cortex 1). Company leaders and innovators can experience the “serendipitous collisions” as well-as focused collaborations that are so desirable in fast-moving technology-oriented business sectors.

The degree to which Cortex has developed into a dynamic innovation hub is now reflected in the attraction of major national and multi-national corporations establishing branch locations at Cortex – seeking to become part of a creative innovation culture. Major companies with operations at Cortex now include major brands, such as: AB Mauri; Accenture; Aon; Boeing; Booz Allen; Cardinal Health; Dupont Nutrition and Health; Emerson Electric; Expedia; ESRI; Express Scripts; MasterCard Technologies; Microsoft; Nestle Purina, and Roche International. It is also notable that regional universities have also established a footprint in Cortex, with Western Illinois University and Truman State University, joining a Cortex community that already includes SLU, WUSTL and UMSL.

a. Patents Held by Companies at Cortex

Innovation activity will also be reflected in intellectual property (IP) data registrations. For “hard” technologies, such as drugs, medical devices, instruments and IT hardware, etc. the innovator may choose to protect their IP by filing for patent protection. For other technology areas, however, (most notably in software for example) innovators may not be developing tech that is patentable or may choose not to patent even if the tech is patentable (choosing instead to hold their IP as trade secrets). With the Cortex Innovation Community containing a broad mix of technology-oriented companies, some in IT, software and associated apps, and others in biopharmaceuticals and healthcare products, there is a mix of patented and non-patented IP in play within the district. Patents thus represent a measure of innovation activity, but not an all-encompassing one. Still, it is useful to examine the patenting activity associated with Cortex-based innovators. Table 8 shows the level of patenting associated with entities located in, or affiliated with, Cortex. Using the Derwent Innovation patent analysis database TEconomy matched the Cortex client lists to innovators in the dataset. Overall a universe of 1,805 patent applications and 1,477 issued patents were identified for the broad Cortex community, also encompassing the immediately adjacent universities (WUSL and SLU). These divide into 146 patent applications and 113 issued patents going to core tenants at Cortex (that is companies that are headquartered at Cortex or R&D centers that are located in the district). Many more patents are held by companies that have a presence within Cortex, but it cannot be assumed that the protected IP is for technology actually developed within Cortex boundaries. For example, Emerson Electric is present in the district, but it is likely the majority of its patents are developed outside of the district.

Table 8: Patent Applications and Issued Patents Associated with Cortex Innovation Community Clients. (2010 through 2018).

Cortex Relevance	Patent Applications	Issued Patents	Total ²⁰
Core Tenants (HQ/R&D Centers)	146	113	259
Related (Branch offices w/in Cortex)	1,021	981	2,002
University (SLU or Wash U)	638	383	1,021
Totals	1,805	1,477	3,282

Source: TEconomy Partners analysis of U.S. patents using the Clarivate Analytics' Derwent Innovation patent analysis database.

The patents associated with the core Cortex client companies headquartered within the district are shown on Table 9. 25 companies comprise the universe of patents so held. Stereotaxis has the highest volume (56), followed by Dupont Nutrition & Health (43), Confluence Discovery Technologies (24), Orion Genomics (23), Aisle411 (15) and Kypha (11). Life science focused companies dominate the list.

Table 9: Patent Applications and Issued Patents Associated Held by Cortex HQ'd Companies/Core Client Organizations. (2010 through 2018).

Cortex Key Tenant	Patent Applications	Issued Patents	Total
Affigen	1	1	2
Aisle411	10	5	15
Arch Innotek	2	0	2
Array Bridge	2	1	3
Auxagen	0	2	2
BacterioScan	11	5	16
C2N Diagnostics	9	1	10
Cofactor Genomics	3	0	3
Confluence Discovery Technologies	12	12	24

²⁰ For Tables 8 and 9 the totals are distinct. Once an application becomes a granted patent it is not included in the application counts.

Cortex Key Tenant	Patent Applications	Issued Patents	Total
DuPont Nutrition & Health - Protein Solutions	34	9	43
Euclises Pharmaceuticals	6	2	8
Euphrates Vascular (fka Pulse Therapeutics)	12	10	22
Geneoscopy	1	0	1
Immunophotonics	3	0	3
Integrated Aquaculture International	1	0	1
Kereos, Inc.	0	1	1
Kypha	7	4	11
Matatu	1	0	1
Nanopore Diagnostics	1	0	1
Neurolutions	4	1	5
OpenCell Technologies	3	1	4
Orion Genomics	14	9	23
Prattle Analytics	1	0	1
Stereotaxis	7	49	56
VaxNewMo	1	0	1
Totals	146	113	259

Source: TEconomy Partners analysis of U.S. patents using the Clarivate Analytics' Derwent Innovation patent analysis database.

b. STTR and SBIR Activity in the Cortex Innovation Community

Two major federal programs are focused on supporting the commercialization of innovative R&D in the U.S.

- **The Small Business Technology Transfer (STTR)** program encourages joint venture opportunities for small businesses and nonprofit research institutions (including universities). As noted by the Government, “the unique feature of the STTR program is the requirement for the small business to formally collaborate with a research institution in Phase I and Phase II. STTR’s most important role is to bridge the gap between performance of basic science and commercialization of resulting innovations.”²¹
- **The Small Business Innovation Research (SBIR)** program provides funds that encourage domestic small businesses to engage in Federal Research/Research and Development (R/R&D) that has the potential for commercialization. As noted

by the Small Business Administration, “through a competitive awards-based program, SBIR enables small businesses to explore their technological potential and provides the incentive to profit from its commercialization.”²²

Gaining access to SBIR/STTR funding is highly competitive and generally indicative of R&D activity with strong technology fundamentals and potential for commercialization. As such, the receipt of funds through these programs provides one measure of innovation activity taking place within the Cortex Innovation Community. Table 10 shows the companies located, or formerly located, within the Cortex Innovation Community that have received funding from the SBIR and STTR programs (the majority being SBIR program funded). These data show that 13 current or graduated Cortex Innovation Community companies have received a combined total of \$4,777,406 from the SBIR/STTR programs. Medros, Inc. and Lickenbrock Technologies, LLC are the two largest recipients of funds, each receiving just over \$1 million in total. AP Materials is third in total SBIR/STTR funding with (\$0.9 million) in funds.

21 <https://www.sbir.gov/about/about-sbir>
22 <https://www.sbir.gov/about/about-sbir>

Table 10: Company Recipients of SBIR/STTR Funds Located in the Cortex Innovation Community

Company	Program	Phase	Award Year	Award Amount
AP Materials	SBIR	Phase I	2003	\$99,999
AP Materials	SBIR	Phase II	2005	\$500,000
AP Materials	SBIR	Phase I	2003	\$99,998
AP Materials	SBIR	Phase I	2002	\$69,670
AP Materials	SBIR	Phase I	2002	\$69,852
AP Materials	SBIR	Phase I	2002	\$69,925
APT Therapeutics, Inc.	SBIR	Phase I	2010	\$287,622

Company	Program	Phase	Award Year	Award Amount
Araha, Inc.	STTR	Phase I	2005	\$100,000
Araha, Inc.	SBIR	Phase I	2005	\$100,000
Biosynthema, Inc.	SBIR	Phase I	2003	\$100,000
C2N Diagnostics, LLC	SBIR	Phase I	2009	\$133,098
Confluence Life Sciences, Inc.	SBIR	Phase I	2013	\$289,278
DNA Polymerase Technology, Inc.	SBIR	Phase I	2001	\$107,856
DNA Polymerase Technology, Inc.	STTR	Phase I	2000	\$154,502
Kypha, Inc.	SBIR	Phase I	2011	\$273,487
Lickenbrock Technologies LLC	SBIR	Phase I	2016	\$149,820
Lickenbrock Technologies LLC	SBIR	Phase II	2015	\$375,000
Lickenbrock Technologies LLC	SBIR	Phase I	2009	\$99,919
Lickenbrock Technologies LLC	SBIR	Phase I	2008	\$220,548
Lickenbrock Technologies LLC	SBIR	Phase I	2008	\$159,077
Medros, Inc.	SBIR	Phase I	2010	\$150,000
Medros, Inc.	SBIR	Phase I	2010	\$152,114
Medros, Inc.	SBIR	Phase I	2009	\$136,313
Medros, Inc.	SBIR	Phase I	2008	\$137,071
Medros, Inc.	SBIR	Phase I	2008	\$132,480
Medros, Inc.	SBIR	Phase I	2007	\$132,178
Medros, Inc.	STTR	Phase I	2007	\$164,300
Minmax Technologies	STTR	Phase I	1998	\$65,000
Orion Genomics, LLC	SBIR	Phase I	2005	\$98,781
Singulex, Inc.	SBIR	Phase I	2007	\$149,518

Source: TEconomy Partners analysis of data from SBIR.gov.

c. Access to R&D Core Facilities for the Cortex Innovation Community

The performance of R&D, especially by bioscience ventures, may require access to highly specialized and expensive scientific research equipment and instrumentation. With the founding institutions of Cortex comprising world class scientific research universities and institutions, there is a rich variety of such assets that facilitate access for Cortex resident companies. Facilities include those shown on Table 11.

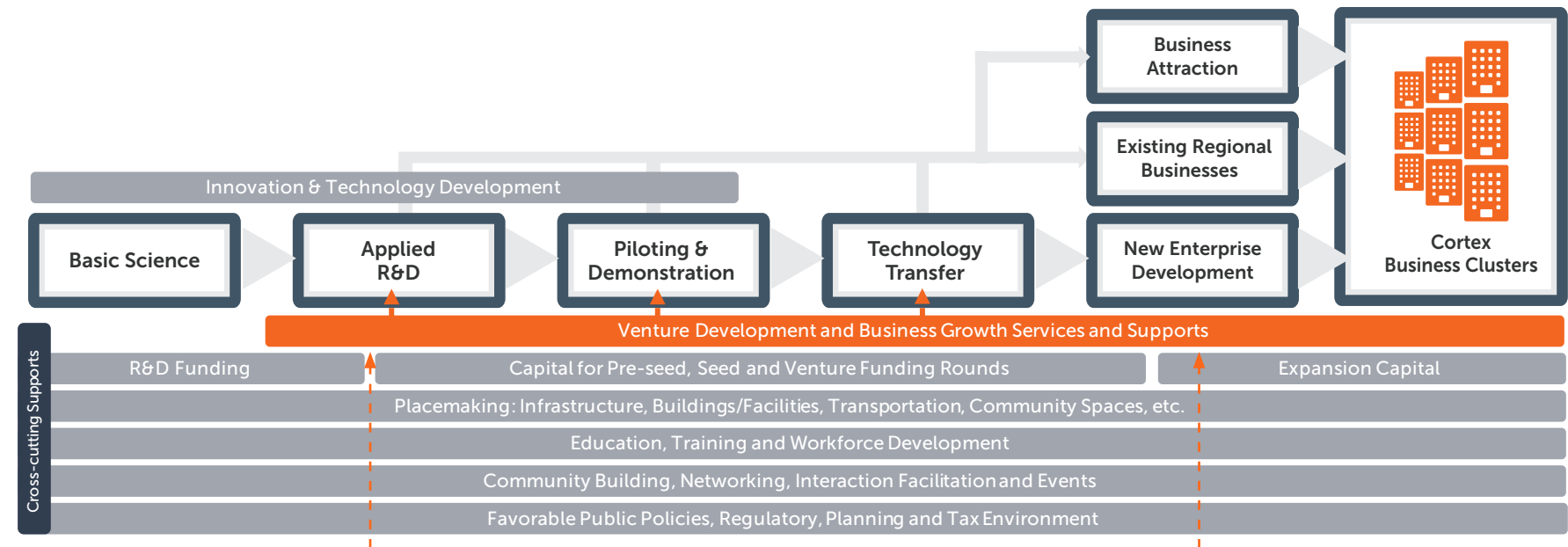
Table 11: Research Core Facilities Accessible by Cortex Innovation Community Clients by Agreement

Institution	Research Core Facilities
Donald Danforth Plant Science Center	<ul style="list-style-type: none">• Proteomics and Mass Spectrometry• Tissue Culture and Transformation• Integrated Microscopy• Plant Growth Facility
St. Louis University	<ul style="list-style-type: none">• Department of Comparative Medicine• Research Microscopy and Histology Core• Genomics Core facility• Protein Core Facility
University of Missouri-St. Louis	<ul style="list-style-type: none">• Microscope Imaging and Spectroscopy Technology Laboratory• High resolution NMR Facility• X-ray Diffraction Laboratory• Mass Spectrometry Facility
Washington University in St. Louis	<ul style="list-style-type: none">• Biologic Therapy Core Facility• NIH/NIGMS Biomedical Mass Spectrometry Resource• High-Throughput Screening Center• Center for Cellular Imaging• Siteman Flow Cytometry• Genome technology Access Center• High Resolution NMR Facility• Hybridoma Center/Monoclonal Antibody Development Core• Immunomonitoring Laboratory• Proteomics Shared Resource

2. Ecosystem Functions in Venture Development and Business Growth Services and Supports

Cortex is home to a broad range of organizations and associated programs that serve to incubate, accelerate, advise and support new business ventures and their entrepreneurial leadership. The Center for Emerging Technologies, BioGenerator and Capital Innovators each are engaged in multiple programs. Figure 11 summarizes key programs identified:

Figure 11: Venture Development and Business growth Services and Supports – Engaged Parties and Programs



Program Name	Providing Organization	Description	Program Name	Providing Organization	Description
Ameren Accelerator	Capital Innovators, UMSL, Ameren	Five to seven companies focused on energy and sustainability are selected to participate in a 12-week accelerator program, including \$100,000 in funding as well as office space, mentorship, and engagement with Ameren.	SBIR/STTR Training	Center for Emerging Technologies (CET)	CET provides workshops, training and coaching for writing successful grant requests
BioGenerator	BioGenerator	BioGenerator invests and mentors life science companies, including providing space in the Accelerator Labs located in the Cortex I building.	Sling Health	Sling Health	A student-run biomedical technology incubator providing resources, training and mentoring to teams of students developing innovations to identified clinical challenges.
Capital Innovators Accelerator	Capital Innovators	Capital Innovators invests in startup companies (largely in IT) and provides them with mentorship, networking, back office tools and support, and other resources.	Square One Bootcamp	Center for Emerging Technologies (CET)	A 10-week session for early-stage entrepreneurs. Focuses on serving first-time owners developing businesses in bioscience, IT, manufacturing, or consumer products.
Fundamentals	BioGenerator	Customized one-on-one coaching, mentoring and classes for the founders of life science start-ups	Square One Ignite	Center for Emerging Technologies (CET)	A 4-week program created to help entrepreneurs validate their business model and provide them with introductions to local entrepreneur support organizations and mentors.
MedLaunch	MedLaunch	MEDLaunch is a non-profit, biomedical and entrepreneurship incubator partnering with Saint Louis University and other organizations in the Saint Louis area.	Square One Level Next	Center for Emerging Technologies (CET)	Some Square One Bootcamp graduates receive six months of follow-on mentoring and support for their business.

The extent of the corporate ecosystem that has been developed at Cortex is impressive by any standard. Consider the following statistics (as of December 2018)²³:

- CIC@CET (20 S. Sarah) contains 157 tenant organizations employing 502 personnel
- CIC@4240 (4240 Duncan) contains 77 tenants employing 1,005 personnel, while CIC@4220 (4220 Duncan) contains 54 tenant organizations and 196 personnel.
- BJC @ The Commons contains 1,065 employees within two companies
- BioGenerator has 52 operations employing 212 personnel
- Cortex I is home to 8 operations and 224 personnel.
- Another 19 distinct corporate sites and community organizations in the district account for 2,576 personnel.

Together this sums to 369 Cortex client operations employing 5,780 direct personnel, the majority of which are technology-based business enterprises or institutions/organizations interfacing directly with tech sectors and technological innovation.

As can be seen on Figure 11, the ecosystem of the Cortex Innovation Community contains multiple organizations that are direct resources and services towards the development and growth of business ventures. Through this ecosystem, entrepreneurs, start-ups and fast-growing business enterprises are able to access a comprehensive suite of services including:

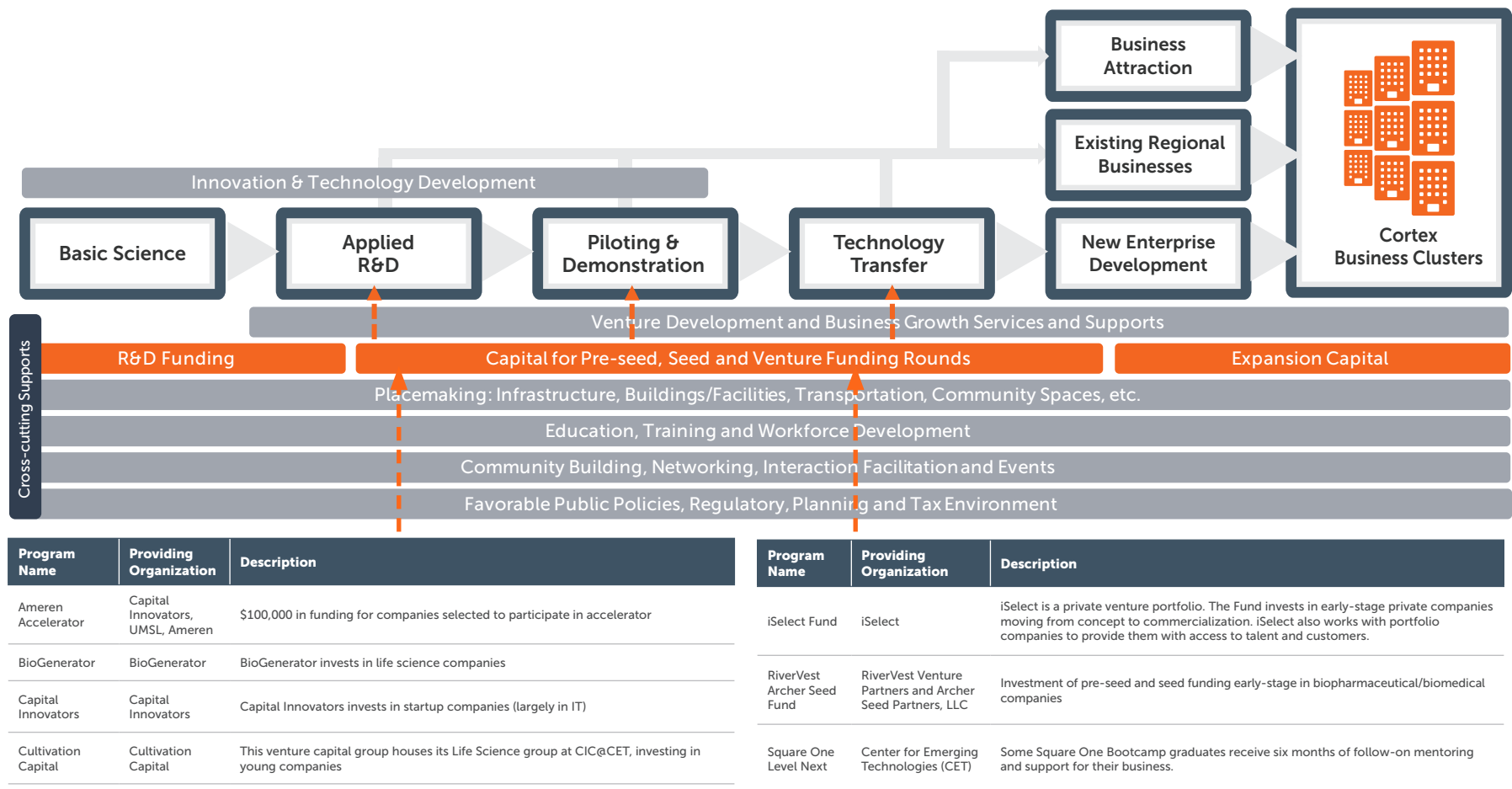
- Access to co-working, incubator and accelerator space
- Access to lab space and pilot/scale-up equipment and scientific instrumentation
- Formal training in entrepreneurship and business venture management
- Access to skilled business advisors, mentors and service providers
- Networking opportunities and access to a community of like-minded entrepreneurs
- Training and support for accessing capital for business development and growth
- Technology transfer and intellectual property licensing guidance.

²³ See Appendix B for complete client list for the Cortex Innovation Community.

3. Ecosystem Functions in Capital for Pre-Seed, Seed, Venture Capital Rounds and Expansion Capital

Gaining access to financial capital for starting and growing a business enterprise is frequently cited as a key barrier to new business growth in regions throughout the United States (except for exceptions in well resourced locations on the east and west coasts). At Cortex, however, the ecosystem benefits from having the presence of multiple risk capital and venture funding organizations located on-site and providing funding to Cortex-based and other regional ventures. Figure 12 summarizes key capital providers and programs identified:

Figure 12: Capital at Cortex – Engaged Parties and Programs

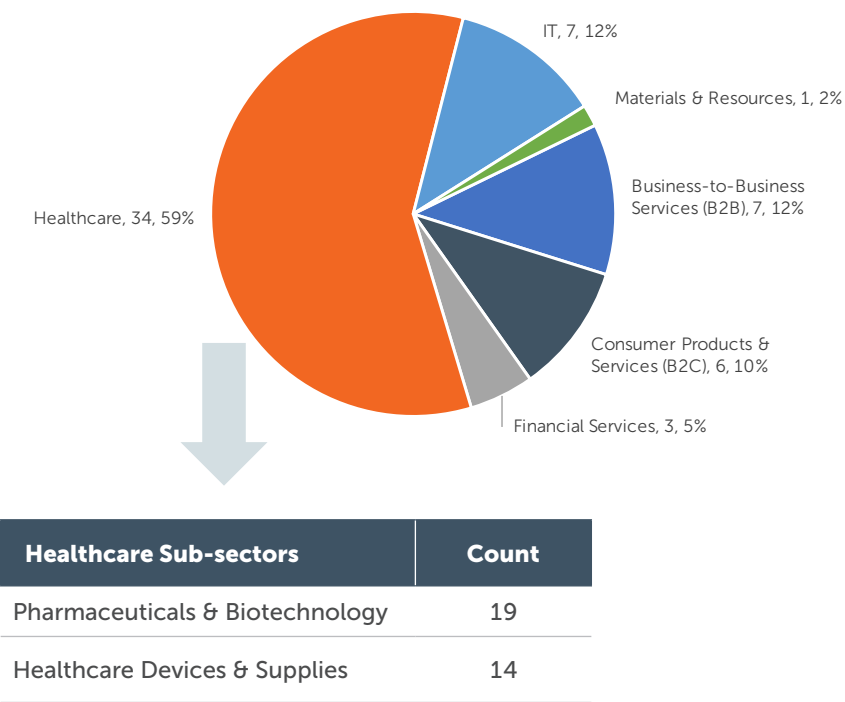


a. Funding of Commercial Business Ventures at Cortex – Data from Pitchbook

Raising capital from risk/private equity capital markets is an important component of starting-up and scaling fast-growing technology business enterprises. One of the most frequently cited barriers for new commercial ventures (particularly outside of the east coast and west coast hotbeds of venture capital) is the challenge of raising private funding and attracting investment from certified angel and VC investors. The Cortex Innovation Community has paid particular attention to maintaining active contacts with private capital providers and, indeed, the innovation district includes offices and operations of several well-capitalized investment entities (Table 12). The extent to which the Cortex Innovation Community has been successful in attracting capital providers to invest in Cortex companies is perhaps best reflected in the fact that there are currently 113 active investors.

Many of the early stage business ventures located at Cortex – especially those located in the co-working spaces, are too early in their development to have attracted formal external investment. However, given the length of time that the Cortex Innovation Community has now operated, there has been a substantial volume of Cortex-based companies that have attracted such capital. Pitchbook is the premiere provider of data covering private capital markets, including venture capital, private equity and M&A transactions. TEconomy subscribes to Pitchbook and performed custom analysis of the Pitchbook database to identify Cortex-based company deals for companies that are still active (Table 12). The results show a healthy business funding environment at Cortex, with 58 current Cortex companies listed in the Pitchbook database as having received significant funding. As a group, these 58 currently-operating companies have raised \$392.81 million in capital (for an average of \$6.77 million per company) and report over 3,091 employees (an average of 53.3 personnel).

Figure 13: Primary Industry Sectors of Private Equity Funding for Cortex Innovation Community Companies (Sector, Companies, Percent of Total)



The full list of active investors is provided in Appendix A, while the investment organizations with two or more active investments in Cortex ventures are shown on Table 12. Also listed on the table, in a separate column, are investments that have reached maturity in currently operating Cortex companies and are thus listed as inactive.

Table 12: Investors/Investment Companies with Two or More Investments in Currently Active Cortex Companies

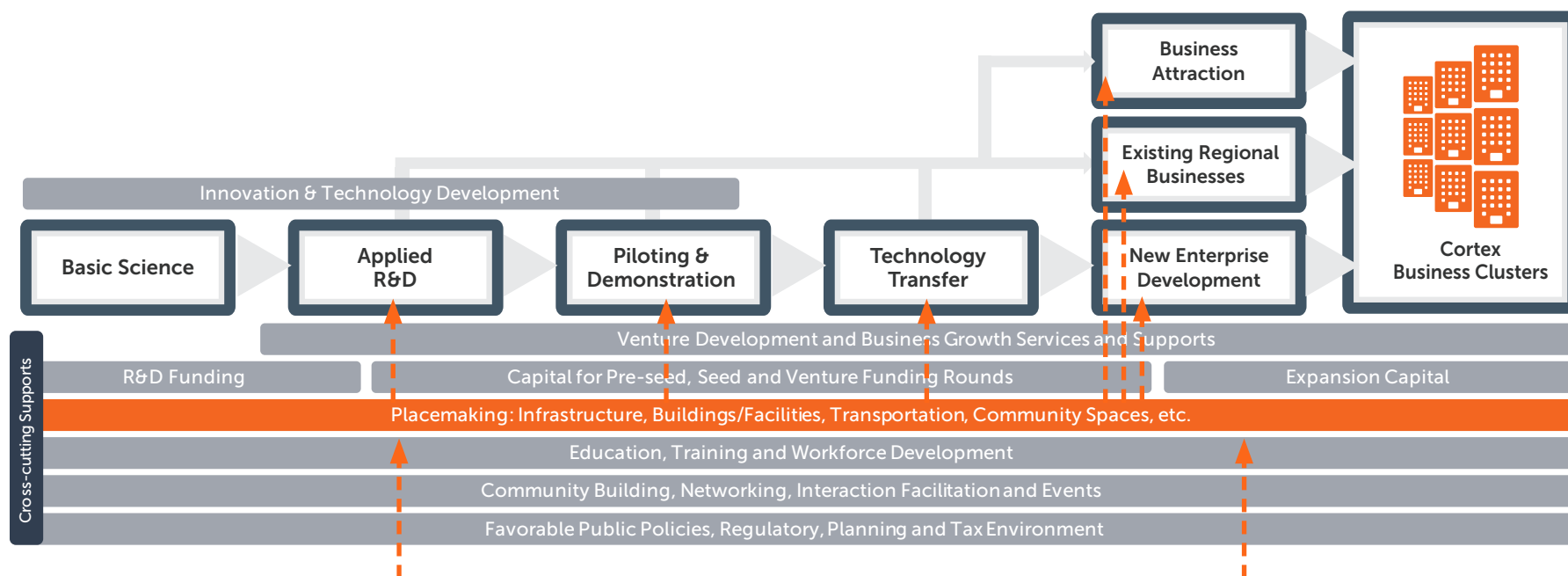
Investment Company/Organization	Number of Active Investments in Current Cortex Companies	Number of Previous Investments in Current Cortex Companies that are Matured.
BioGenerator	21	5
Missouri Technology Corporation	15	2
Accelerate St. Louis	12	2
Arch Grants	11	
St. Louis Arch Angels	10	2
Cultivation Capital	8	
Billiken Angels Network	5	
Sling Health Network	4	
iSelect Fund	4	1
Capital Innovators	4	
Washington University in St. Louis Endowment	4	
Argonautic Ventures	3	
Plug and Play Tech Center	3	
National Science Foundation	3	
Holton Capital Group	3	
U.S. Department of Health and Human Services	3	1
National Institutes of Health	3	
Skandalaris Center	2	
Pinpoint Holdings	2	
Lord Rothschild	2	

4. Ecosystem Functions in Placemaking, Including Infrastructure, Building and Facilities Development, Transportation Infrastructure and Community Spaces

With an innovation district two central elements come together – 1) R&D-based innovation and associated commercialization activity and 2) placemaking – the making of a physical district. In the case of the Cortex Innovation Community, the 200 acres within the district boundaries were characterized prior to the development by urban blight and post-industrial decline of the built environment and infrastructure. Through master planning and strategic investment, facilitated by a diversity of key stakeholders, Cortex has been transformed into the go-to place for tech companies in the region. As noted by Dr. Fred Pestello, the President of St. Louis University, in an interview with TEconomy, prior to Cortex the “area was a vacant, problematic mess. Cortex has taken a blighted area and turned into a dynamic, gleaming and alive space.”

Achieving the physical transformation of the district has required a coordinated approach to planning infrastructural improvements, streetscape and landscape improvements, and the construction and renovation of buildings to house R&D, new business ventures and the operations of existing businesses and organizations to locate within the district. Since inception, Cortex has completed or has under construction 2 million square feet of new and rehabilitated space totaling over \$700 million of investment. Figure 14 summarizes key placemaking elements and the developer and engaged parties identified:

Figure 14: Placemaking – Programs and Developments



Development	\$ Construction	Description
4220 Duncan	\$40,600,000	Completed except for Innovation Hall (\$4,200,000) in progress. Five stories and 182,000 square feet of multi-tenant commercial space, featuring a two-story atrium lobby, a full-service restaurant, indoor and outdoor event and conference space, and a full-service health club.
@4240 (Cortex 1)	\$40,100,000	Completed. 152,403 square foot office and lab space. Houses WUSTL research facilities as well as new private companies formed to commercialize the research. Also home to BioGenerator supporting the capital and laboratory needs of over 65 bioscience startups.
BJC @The Commons	\$25,300,000	Completed. 220,000 square feet consolidating BJC administrative functions.
4260 Forest Park	\$22,569,000	Completed. Three stories and 60,000 square feet of multi-tenant office/tech space.
Commons and Streetscape 1	\$9,000,000	Completed. 3.5-acre Cortex Commons, a green space that opened in summer of 2015 outside @4240.
BioGenerator Expansion	\$2,100,000	Completed

Development	\$ Construction	Description
CIC@CET – Phases I & II	\$1,900,000	Completed. Office, co-working and lab space. Houses CET and is one of three Cortex buildings housing CIC operations.
4340 Duncan (Crescent Building)	\$44,000,000	In progress. In development to house office, coworking and lab space for BioGenerator and its client organizations.
4217 Custom Steel (Garage)	\$12,000,000	The five-level parking garage has spaces for 678 vehicles. First of three parking garages planned.
4052 Forest Park (North Silo)	\$780,000	Completed parking lot
Duncan Avenue Sewer Infrastructure	\$944,000	Completed
MetroLink Rail Station	\$14,000,000	Completed. Located between the Central West End and Grand MetroLink Stations, it is the 38th MetroLink station.

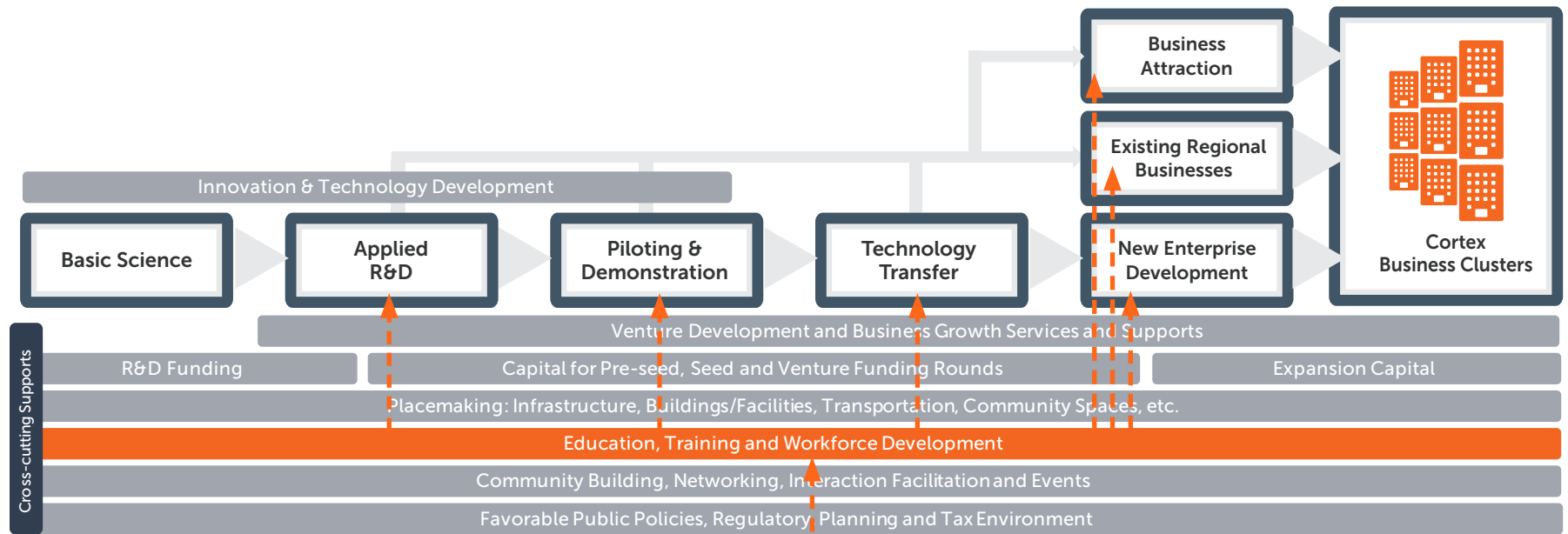
5. Ecosystem Functions in Education, Training and Workforce Development

Education and workforce development tend to be an economic development function that is conducted at a major regional level (rather than by a relatively compact innovation district) or focused towards specific sectors (e.g. bioscience education and workforce development, IT education and workforce development, etc.). The challenge for an innovation district to engage in education and workforce development is that districts do not have a controlling influence over the public and private providers of K-12, higher education and workforce training and skills development programs. What an innovation district, such as Cortex, can do is be a key constituent and advocate for education and training that is relevant to the business sector mix within the district. Cortex is engaged in this regard, providing input, advice and membership-level participation with STEM education and workforce development programs within the St. Louis region. Cortex is proactive in communicating the future talent needs of its client companies and organizations – seeking to insure that the educational credentials and workforce skills of Cortex tech sectors are given a priority in the education and training policy and

program decisions of regional leaders. The other means for Cortex to impact education and workforce development is through the fundamental placemaking activity of the district – working to create a modern live/work/play/learn environment that is attractive to employers and the highly talented individuals they seek to recruit.

At the present time, the main education programs that are actually located within the Cortex Innovation Community are collaborative programs focused primarily on cybersecurity related education and training (Figure 15). Cortex is also working with school districts, regional training providers and higher education institutions to introduce their students to the Cortex Innovation Community, hosting events that encourage students to experience the innovation district and the exciting and diverse employment opportunities therein.

Figure 15: Education, Training and Workforce Development– Engaged Parties and Projects



Program Name	Providing Organization	Description
COLLAB	Washington University in St. Louis and Saint Louis University sharing space; Cortex assisting with programming.	WUSTL's cybersecurity graduate program and SLU's Office of Research will share space in this Collaborative. It is meant to be an open, shared space for industry/academic collaboration, including in the fields of talent recruitment/retention, research partnerships, and community engagement.
Gateway Higher Education Cybersecurity Consortium	Washington University in St. Louis coordinates content; Cortex coordinates meetings	An academic consortium with the mission of filling cybersecurity jobs in the St. Louis area and facilitating academic collaboration on research, events, and grants.
Startup Talent Showcase	PluggedIN, Cortex	Cortex partners with PluggedIN for Spring and Fall fairs to connect students with startups and corporations in a matchmaking-style environment.

6. Ecosystem Functions in Community Building, Networking, Interaction Facilitation and Events

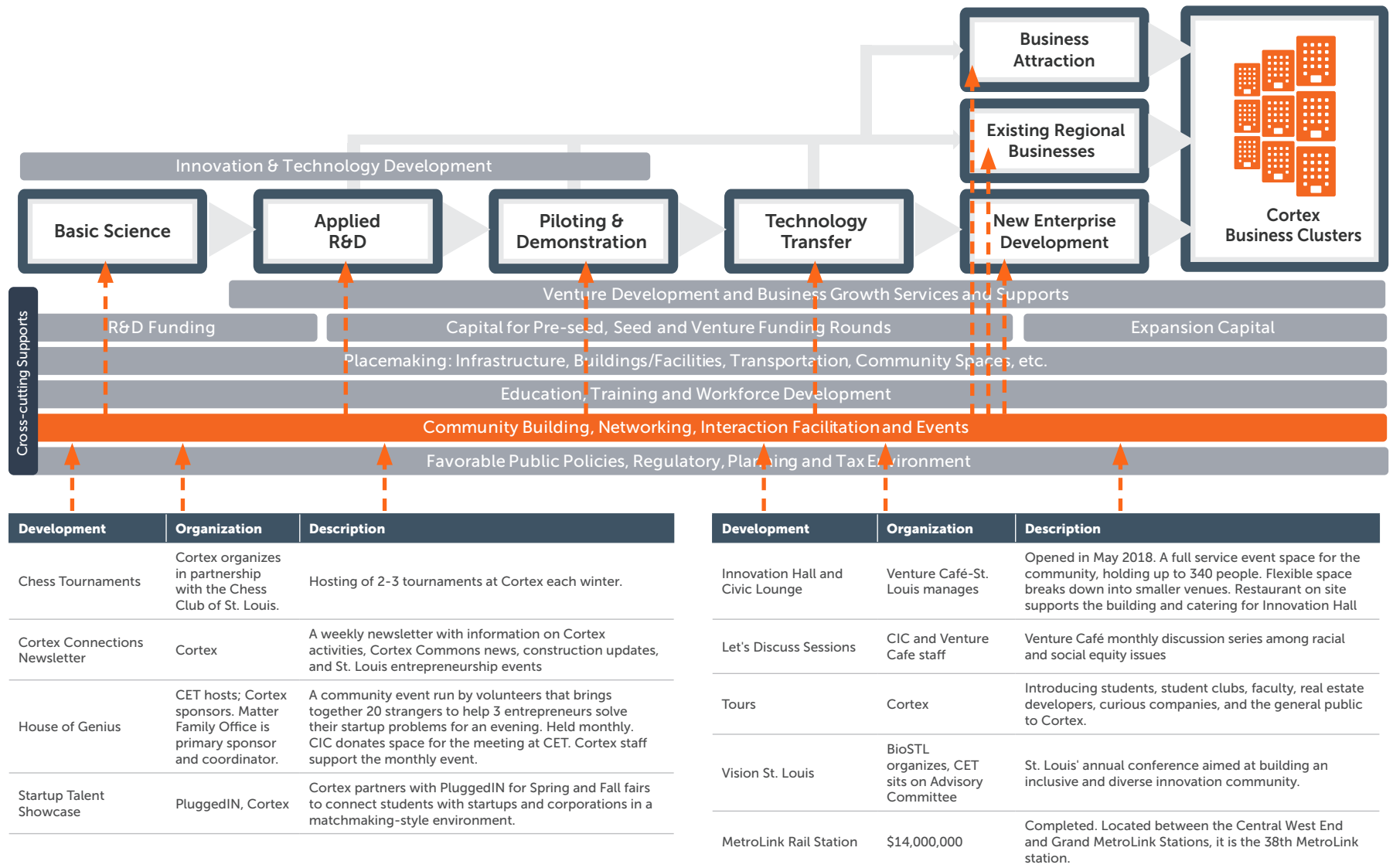
“Community” is in the name of the Cortex Innovation Community for a reason. As noted by researchers at the Babson Entrepreneur Experience Lab:

Entrepreneurs like a place with a density and proximity of entrepreneurial communities. In some locations, entrepreneurs literally bump into each other in the street. In other locations, the event scene provides multiple opportunities to meet and network with other entrepreneurs. A sense of affiliation is important. Places where starting a business is the norm create a strong sense of community, identity, and purpose.²⁴

Being able to interact in a community of like-minded individuals, seek mentors with relevant experience, explore collaborative opportunities, explore convergence opportunities between multiple tech spaces, etc. are community functions that may be facilitated in place-based developments. Cortex and multiple organizations working within the Cortex Innovation Community ecosystem have very much focused on creating a sense of community and facilitating the development of an overall ecosystem and environments within that are conducive to interpersonal interactions and collaborative pursuits. Figure 16 summarizes some of the relevant parties and programs engaged in such community building activity.

²⁴ Heidi Neck. 2010. “The Importance of Place in Entrepreneurship.” The Babson Entrepreneur Experience Lab. Accessed online at: <http://entrepreneurship.babson.edu/the-importance-of-place-in-entrepreneurship/>

Figure 16: Community Building, Networking, Interaction Facilitation and Events – Engaged Parties and Projects



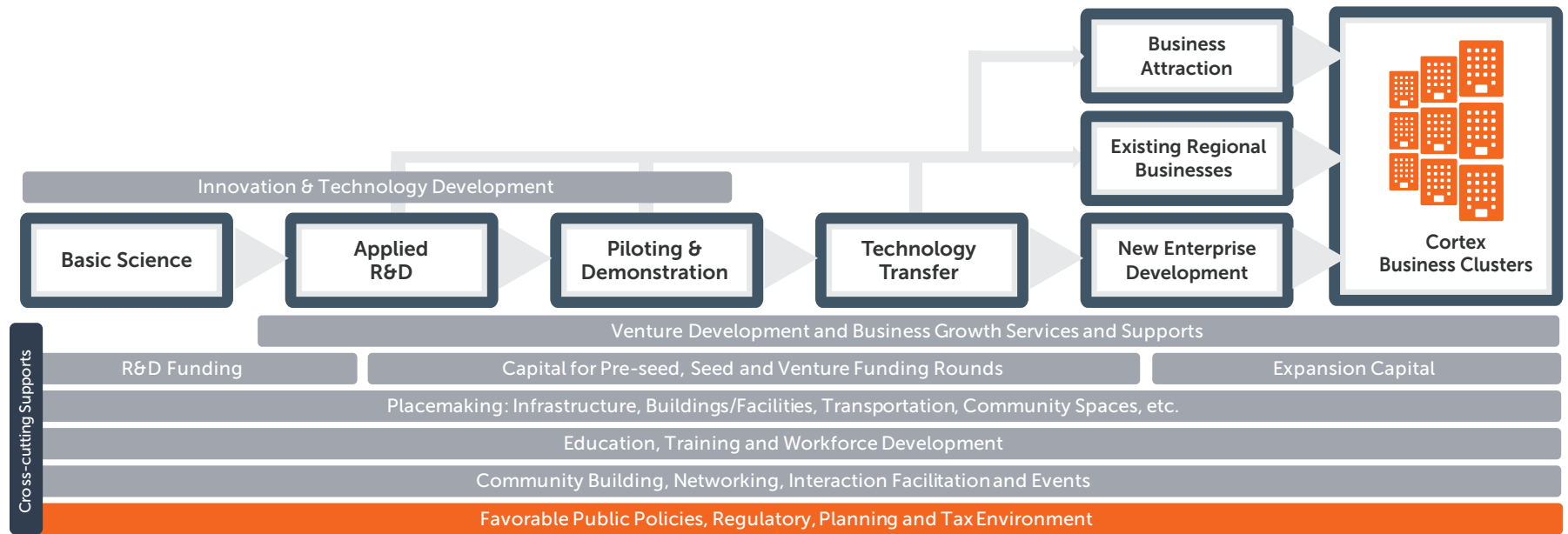
7. Ecosystem Functions in Public Policies, Regulatory, Planning and Tax Environment

The development of an innovation district, like Cortex, is typically the result of multiple public and private sector players and organizations convening around a shared goal for district development. Because a meaningful innovation district needs to be of significant size (in the case of Cortex 200-acres) there will nearly always be multiple land-owners, existing entities, residents, infrastructure providers, etc. that have to be engaged in the development planning process. The scale of innovation district developments also mandate access to favorable public finance options, and the provision of planning permissions and authority to the district from public authorities. This latter factor is particularly important, allowing the vision for the district to be under the control of the district for the long-term, and not subject to changing political forces.

In the case of the Cortex Innovation Community there has been a very strong partnership established between the original visionary leadership organizations supporting the development (BJC, WUSTL, SLU, UMSL and the Missouri Botanical Garden) and the City of St. Louis. The designation of the Cortex 501(c)3 organization as the master development, giving the ability to coordinate and masterplan the development was crucial. The City granted Cortex the ability to use eminent domain (ultimately exercised on only a limited basis) to assemble a contiguous district, and key taxing bodies provided TIF district designation that has been invaluable in securing project financing. A leadership community, coming together to work collaboratively towards a shared vision, and granting Cortex's management and board the powers needed to execute the vision, has enabled a powerful development momentum to be built. Figure 17 summarizes some of the key public policy, regulatory, planning and tax environment characteristics of the community.



















































































Clearly, Cortex is home to a comprehensive technology-based economic development ecosystem – one that comprises multiple providers of individual ecosystem services. Cortex Innovation Community ecosystem programs and providers detail is captured in the previous figures. Figure 18 provides a matrix-based overview of each element and provider in a single simplified graphic. The “Community” element of Cortex is readily apparent in that every individual ecosystem element sees more than one provider active in performing work of direct relevance. It should be noted that this figure covers primary organizations active in Cortex or working with Cortex-based companies – there are multiple other organizations and programs active and contributing to TBED within the broader St. Louis region (for example the Donald Danforth Plant Sciences Center, Helix, T-Rex, etc.). It should be acknowledged that these external organizations have a significant impact on the regional economic development ecosystem of which Cortex is a part.

Figure 17: Public Policies, Regulatory, Planning and Tax Environment – Engaged Parties and Projects



Program Name	Providing Organization	Description
Tax Increment Financing (TIF)	Cortex, authorized by City of St. Louis	Ability to use tax increment financing mechanisms to encourage investment in Cortex buildings and infrastructure by developers.
Tax Abatements	Cortex, authorized by City of St. Louis	Ability to use offer tax abatement (which in the City of St. Louis freezes taxes at a base rate with no increase over a predetermined time period).
Eminent Domain and Associated Authority	Cortex, authorized by City of St. Louis	Ability to acquire property by eminent domain authority.

Figure 18: Matrix of the Cortex Innovation Community Ecosystem Elements and Key Providers of Ecosystem Element Services

			Ecosystem Element Providers															
			CORTEX	CET	BioSTL	BioGenerator	Capital Innovators	CIC St. Louis	City of St. Louis	Cultivation Capital	Individual Tech Co's.	iSelect	MADE	MedLaunch	Research Universities (WUSTL, SLU, UMSL)	Sling Health STL	Venture Café St. Louis	
Primary Provider/Performer																		
Secondary																		
Ecosystem Element																		
Basic Research															 			
Applied Research															 			
Piloting and Scale-up Facilities & Lab Services															 	 	 	
Technology Transfer and Licensing															 			
Pre-Seed/Seed Capital																		
Venture Capital																		
Tax Abatements/TIF/ Credits/Dev. Assistance																		
Incubator/ Accelerator Facilities																		
Master Planning & Development Management																		
Office/Flex Space Development/Leasing																		
Entrepreneurial Development & Mentoring																		
Education & Workforce Development Services															 			
Networking Events & Intellectual Exchange																		
Community Engagement Outreach															 			
SBIR/STTR Assistance and Coaching																		
Business Attraction and Marketing																		

C. ECONOMIC AND SOCIAL DIVERSITY FOR THE ST. LOUIS REGION

The City of St. Louis benefits from a diverse population.

Census population estimates placed the city population at 308,626 in mid-2017, with more than half of the population represented by people of color (Table 13). Diversity in the City is most evident in the City having almost 3.5 times the percentage of its population that is black (47.2%) versus the nation overall (13.4%), and St. Louis County is also represented more highly in this demographic (with 24.7% black). Other non-white populations are present in a lower percentage than the nation overall – thus racial diversity in St. Louis is most prominently represented in its large black population.

Table 13: Race and Hispanic Origin for City of St. Louis Residents and the United States

Race/Ethnicity	Percent of City of St. Louis Population	Percent of St. Louis County Population	Percent of United States Population
White alone	47.2%	68.6%	76.6%
Black or African American alone	46.5%	24.7%	13.4%
American Indian and Alaska Native alone	0.3%	0.2%	1.3%
Asian alone	3.4%	4.4%	5.8%
Native Hawaiian and Other Pacific Islander alone	0.1%	0.1%	0.2%
Two or More Races	2.5%	2.1%	2.7%
Hispanic or Latino	4.0%	2.9%	18.1%

Clearly, it is important that economic development initiatives work to assure that all populations and demographics are presented with quality employment opportunities and have the education and skills required to access the jobs that are available. In St. Louis this requires paying particular attention to the needs of, and opportunities for, minority populations (and most notably the black population given the high percentage of residents so classified).

With the Cortex Innovation Community very much focused on technology-based economic development, there is a need for engagement and initiatives focused on increasing opportunities for minority employment within the district. National data, reported by TechRepublic, show that²⁵:

- **“There are half as many African Americans and Hispanics in tech as in the rest of the private sector.** Compared to overall private industry, the high-tech sector in 2014 employed a larger share of whites (68.5% tech vs. 63.5% private sector), Asian Americans (14% tech vs. 5.8% private sector) and men (64% tech vs. 52% private sector). It also employed a smaller share of African Americans (7.4% tech vs. 14.4% private sector), Hispanics (8% tech vs. 13.9% private sector), and women (36% tech vs. 48% private sector), according to the US Equal Employment Opportunity Commission (EEOC).”²⁶
- **“83% of tech executives are white.** White people are represented at a higher rate in the tech sectors’ executives category than the rest of the private sector, at 83%—more than 15% higher than their representation in the professionals category, which includes jobs like computer programming, according to the EEOC. Other groups are represented at significantly lower rates in the executive category than in the professionals, including African Americans (2% to 5.3%), Hispanics (3.1% to 5.3%), and Asian Americans (10.6% to 19.5%).”²⁷

In the large IT sector of the tech economy, the issue of a lack of black representation in the workforce is readily apparent in the data on Table 14. The IT sector is diverse in terms of having a much higher percentage of its workforce comprising of persons with Asian

ethnicity, in most other ethnicities it is less diverse. Diversity issues in the IT sector are also evident in a disproportionate percentage of the workforce being male versus female.

²⁵ Alison DeNisco Rayome. 2018. “5 eye-opening statistics about minorities in tech. Diversity efforts could net the IT industry an extra \$400 billion in revenue each year. Here’s why.” TechRepublic. Published February 7, 2018. Accessed online at: <https://www.techrepublic.com/article/5-eye-opening-statistics-about-minorities-in-tech/>

²⁶ Ibid

²⁷ Ibid

²⁸ Jeff Desjardins. 2017. “Visualizing the Diversity of the Tech Industry”. Visual Capitalist. Published August 14, 2017. Accessed online at: <https://www.visualcapitalist.com/visualizing-diversity-tech-industry/>

Table 14: Ethnicity and Male/Female Employment Percentages at Leading IT Companies²³

Tech Company	Female	Male	White	Asian	Latino	Black	Multi	Other
Facebook	33	67	52	38	4	2	3	1
Flickr	37	63	45	44	4	2	2	3
Instagram	33	67	52	38	4	2	3	1
Linked In	42	58	54	36	5	3	2	0
Pinterest	44	56	49	41	4	2	4	0
Tumblr	37	63	45	44	4	2	2	3
Twitter	37	63	57	32	4	3	3	0
YouTube	30	70	61	30	3	2	4	0
Amazon	39	61	48	13	13	21	0	5
Apple	32	68	56	19	12	9	2	1
Dell	30	70	68	9	11	10	0	1
Ebay	43	57	60	25	5	8	1	1
Google	31	69	59	32	3	2	3	1
Groupon	47	53	67	17	6	8	0	3
HP	33	67	72	6	14	7	1	0
Indiegogo	45	55	64	23	8	2	0	3
Intel	25	75	53	33	8	4	0	2
Microsoft	26	74	58	31	6	3	2	1
Nvidia	16	84	38	44	3	1	14	0
Pandora	48	52	65	16	8	5	6	1
Salesforce	30	70	65	24	4	2	2	0
Uber	36	64	50	31	5	9	4	1
Yahoo	37	63	45	44	4	2	2	3

Comparison	Female	Male	White	Asian	Latino	Black	Multi	Other
Top 50 U.S. Companies	54	46	68	10	10	12	no data	no data
U.S. Population	50	50	69	4	12	12	1	3

While black Americans represent 13.4% of the U.S. population, they represent an average of just 4.8% (averaging across the tech companies on Table 14) of the leading IT company workforce (the median value is 2.0%). The median value for Latinos of 4% (average across the companies for Latinos is 6.2%) also shows this minority population underrepresented in the IT workforce. Asian populations are highly represented in the IT tech workforce, while women are underrepresented. Clearly the tech workforce (at least in the IT sector of the tech economy) skews quite different from the population of the nation overall, and the profile of employment more generally (for example in the Top 50 U.S. companies as shown in the above table)²⁹.

Analysis by the College Board of National Center for Educational Statistics data show that the employment disparities in tech are largely a reflection of the access to and attainment of STEM education qualifications across populations. The College Board concludes that:

- “Male students are about twice as likely as female students to enter STEM fields; among both men and women, about 40% of those who enter these fields complete a credential and about a quarter earn a bachelor’s degree in a STEM field.”
- “About twice as many Asian as white, black, or Hispanic students enter STEM fields. Completion rates are lowest for black and Hispanic students, with only 16% of those in each of these groups who enter STEM fields earning bachelor’s degrees in these fields, compared to about 30% of the Asian and white students who enter these fields.”³⁰
- Increasing the interest of students in STEM disciplines and raising the awareness of students in the K-12 system of the opportunities in technology-oriented jobs and the high wage levels available.
- Increasing student performance in STEM disciplines.

The latter component is challenging. As the Brookings Institution notes:

Over the past 30 years, a large body of research has shown that four factors consistently influence student achievement: all else equal, students perform better if they are educated in smaller schools where they are well known (300 to 500 students is optimal), have smaller class sizes (especially at the elementary level), receive a challenging curriculum, and have more highly qualified teachers. Minority students are much less likely than white children to have any of these resources. In predominantly minority schools, which most students of color attend, schools are large (on average, more than twice as large as predominantly white schools and reaching 3,000 students or more in most cities); on average, class sizes are 15 percent larger overall (80 percent larger for non-special education classes); curriculum offerings and materials are lower in quality; and teachers are much less qualified in terms of levels of education, certification, and training in the fields they teach.³¹

These data suggest that initiatives that broadly engage encouraging investment in STEM resources and teachers at St. Louis area schools, particularly schools with a high percentage of black students, will be important to improving the opportunity for St. Louis residents to access the high-paying job opportunities at Cortex. Similarly, initiatives introducing black and other minority students and youth to the tech community and getting students to envision themselves in STEM careers will be important. The Cortex Innovation Community has certainly recognized that diversity and social inclusion must be paid attention to – both from a social equity standpoint and from the basic economic reality that the district’s ongoing success depends on companies being able to access an appropriately educated

29 National data are presented because there exists a lack of state and regional/local data pertaining to race/ethnicity participation across specific workforce sectors.

30 The College Board. *Trends in Higher Education. Students in STEM Fields by Gender and Race/Ethnicity*. Accessed online at: <https://trends.collegeboard.org/education-pays/figures-tables/students-stem-fields-gender-and-race-ethnicity>

31 Linda Darling-Hammond. 1998. *Unequal Opportunity: Race and Education*. Brookings Institution. Accessed online at: <https://www.brookings.edu/articles/unequal-opportunity-race-and-education/>

and skilled science and technology savvy workforce. Interviewed by Brookings Institution, Cortex CEO, Dennis Lower, notes that:

We look at inclusion as an integral part of our work and mission at Cortex. We currently have six inclusion initiatives and will soon introduce two more. One of those is the development of a magnet high school in the St. Louis Public School District, the Collegiate School for Medicine and Biosciences. Working closely with the school district's superintendent and an important group of institutional and civic leaders, we have been developing an urban high school centered on one of the major strengths of our Cortex sponsors—bioscience. We recruited our first class in 2013, providing instruction in a small, temporary school, and in 2015 moved to a permanent location that can support 400 students. The students come from all across the region, representing the largest spread of zip codes of any regional public school. Currently, 53 percent of the students are African American, 23 percent are Asian, and 22 percent are white, representing a great mix. Last year's proficiency testing in math and English revealed that we ranked first across the entire public school system. I find this particularly gratifying because a number of incoming freshmen were not performing at grade level. What this tells us is given the opportunity, creative teaching approaches, and a supportive structure, these kids will excel quickly. With our incoming 9th grade class this August, we will have a full complement of freshmen to seniors, graduating our first class in 2017.³²

Cortex, Third Degree Glass Factory (a glassblowing makerspace), Jim McKelvey (local philanthropist and co-founder of Square), and The Magic House (St. Louis' premier hands on STEM children's learning center) collaborated on the creation of a community makerspace at 5127 Delmar Boulevard in St. Louis. Delmar Boule-

vard has been recognized as a socioeconomic and racial dividing line in St. Louis, and the decision to locate the makerspace there is an intentional attempt to bridge this divide. MADE (Makers, Artists, Designers, and Entrepreneurs), which opened in November of 2018, is a 32,000 square foot maker studio, small-scale manufacturing, and prototyping space managed by Third Degree. Cortex provided \$1.2 million of maker equipment, including embroidery machines, 3D printers, a fully-equipped woodshop and metal shop, textile machinery, screen printers, laser cutters, welding tools, paint shop, a waterjet cutter, computers and design software, and more. The Magic House provides year-round STEAM camps, after-school/ weekend programs, and other events for elementary and middle school students at MADE. Cortex provided \$500,000 of scholarship support for local students with limited financial resources to attend these workshops and camps, with the goal of making STEAM education and training accessible to all St. Louisans at an early age.

The commitment of the Cortex Innovation Community to inclusion and workforce diversity is evident in a series of programs and initiatives that Cortex is engaged in and supporting (Table 15). Appendix B provides a synopsis of the purpose and charge of the Cortex Board of Directors Inclusion Committee and examples of the forms used to assess equity for both construction and user projects.

³² Julie Wagner. 2016. "Metropolitan Revolution. In St. Louis, a gateway to innovation and inclusion." Brookings Institution. Accessed online at: <https://www.brookings.edu/blog/metropolitan-revolution/2016/05/05/in-st-louis-a-gateway-to-innovation-and-inclusion/>

Table 15: Cortex 501(c)3 Inclusion Initiatives and Programs

Area of Focus	Initiatives and Programs
Organizational governance, advising, policies and guidelines to assure inclusion is a core focus for Cortex ³³	<ul style="list-style-type: none"> • Creation of a diverse Cortex Board Inclusion Committee made up of community partners, Board members, and innovation center partners, to advise the Board on programs and policies around diversity, inclusion, and equity. The Inclusion Committee is charged with an ongoing evaluation of the effectiveness of current efforts and the creation of new efforts and initiatives that will serve to build and sustain an equitable Cortex Innovation Community. • Incorporating equity lenses – with a particular focus on race/ethnicity and gender equity and including those reflecting foreign-born/immigrant, ability, cultural background, sexuality, and socioeconomic status/class – into Cortex decision-making, policies, programs, and partnerships • Regularly auditing Cortex, its programs, and their impact on and commitment to social equity, with analysis categories that include race, gender, sexual orientation, ethnicity, socioeconomic status, and ability • Developing and utilizing a mechanism for collecting and disaggregating demographic, economic, and attitudinal data of Cortex companies and employees • Offering ongoing training programs in diversity, inclusion, and equity for Cortex staff, Inclusion Committee members, and District leadership
Equity in entrepreneurship and new business development	<ul style="list-style-type: none"> • Working as a co-creating partner with the Equity in Entrepreneurship Collective, a collaborative effort with institutional partners and innovation centers to ensure that systems built to support entrepreneurs are equitable across race and gender
Evaluating construction projects to determine inclusivity in their use of contractors and contractors' employment profiles	<ul style="list-style-type: none"> • Working with developers and contractors on district construction projects to meet and exceed goals for contracting with minority and women-owned businesses and deploying a diverse workforce, as well as participating in ongoing city and regional discussions related to construction enterprise and workforce goals

In addition to the above activities of the Cortex 501(c)3, many of the organizations that are core stakeholders in Cortex and operating within the Cortex Innovation Community have proactive diversity and inclusion initiatives. Examples include those shown on Table 16.

³³ From the Cortex Vision Statement. "Vision for Building an Equitable Innovation Community." Accessed online at: <https://cortexstl.com/vision-statement/>

Table 16: Inclusion Initiatives and Programs of Key Organizations in the Cortex Innovation Community

Organization	Inclusion Program
BioSTL	BioSTL notes that the “Bioscience & Entrepreneurial Inclusion Initiative strengthens the region’s bioscience ecosystem by identifying high-potential, talented women & minority bioscience entrepreneurs and providing a systematic pathway for them to create viable high-growth ventures. This is accomplished through Entrepreneurial Inclusion Pipeline Programming and the convening of the St. Louis Equity in Entrepreneurship Collective.”
BJC	BJC has a series of “Connections” programs that are designed to connect people of diverse backgrounds and foster a sense of inclusion. These groups are designed to support people of color, diverse nurses, those with disabilities, the LGBT population, veterans, and young professionals.
CET	In the “Square One Bootcamp” program, CET partners with the BioSTL Inclusion Initiative and intentionally recruits participants who are women and people of color. CET has also held a “Diversity in Mentoring” event to provide entrepreneurs with access to mentors of similar backgrounds.
CIC St. Louis	In 2017, CIC worked with the Diversity Awareness Partnership to assess inclusivity in their spaces. CIC set goals for 2018 that involved addressing concerns discussed in that assessment. CIC has also created a staff-led Racial Equity Team.
Venture Café St. Louis	Venture Café emphasizes inclusive gathering spaces, support for innovators of all backgrounds, increased opportunity for social mobility.

BJC is also active in reaching out to area K-12 schools to encourage interest and engagement in health and science oriented careers (which, as noted above, is a definite need with multiple minority populations who are underrepresented in STEM fields). Through the BJC School Outreach and Youth Development program, high school students are enabled to explore career options via job shadowing opportunities. A more intensive program is the Pre-Professional Health Sciences Academy offered by BJC in partnership with Special School District and Parkway School District to high school seniors interested in health and biomedical careers. This program combines classroom learning with job shadowing and networking with health care professionals.

D. INCLUSION AND SOCIAL EQUITY IN CORTEX CONSTRUCTION PROJECTS

Cortex Innovation Community management have paid close attention to assuring Cortex construction projects meet a series of goals for minority and women-owned business contracting.

The St. Louis Area Agency on Training and Employment (SLATE) maintains workforce participation information and the collected data allow for analysis of the extent to which Cortex projects ae meeting inclusion goals. Data indicate that across 31 construction projects at Cortex, totaling \$283.8 million in contract value, Cortex exceeded City of St. Louis goals for both minority-owned business contracts and women-owned business contracts. The goal for contracting with minority businesses was for an average of 25% of total contract value to be awarded to businesses in this category, with Cortex exceeding this value and awarding 26%. The goal for women-owned businesses contracts is 5%, and Cortex provided 16% of contracts to businesses so designated.

Goals are also set for the race and gender make-up of the construction workforce engaged in projects at Cortex. The City of St. Louis has a set goals for:

- 25% of labor hours performed by minorities
- 5% of labor performed by women
- 20% of labor hours performed by City residents
- 15% of labor hours performed by apprentices enrolled in approved training programs.

Cortex data show that these goals have been met, or came very close to being met, across each goal metric. Table 17 summarizes the data as of December 2018 reported by Cortex.³⁴

Cortex is also helping minority and women owned construction contractors to access construction and business expansion loans. Cortex is one of the founders of the Contractor Loan Fund, which comprises a coalition of local governments, non-profit organizations and private sector businesses committed to building a more inclusive region.

Table 17: Goals and Performance Metrics for Workforce Inclusion in Cortex Construction Projects (Weighted Average)

Hours to Date	Minority Performed	Women Performed	City Resident Performed	Apprentice Performed
Cortex Achieved	24%	5%	15%	13%
Goal	25%	5%	20%	15%

³⁴ Data accessed online at: <https://cortexstl.com/inclusion/>

It is clear that the Cortex Innovation Community and the key organizations engaged in the Cortex ecosystem are committed to building a community that is inclusive and appropriately reflects the diversity of the population of St. Louis. For Cortex construction projects data show that a commitment to inclusion is working. Unfortunately, data are not available regarding racial and other diversity metrics for the daily population that works at the more than 300 companies and organizations within the Cortex Innovation Community. Gathering such data at the micro level of a 200-acre development will require

a survey to be administered to all Cortex clients, but previous experience in the community with surveys anticipates a low response rate and thus significant non-response bias in survey results. It is likely that, given the high proportion of black residents in St. Louis, and the historic underrepresentation of the black population in the tech sector, that attention must continue to be paid to the development of a high-performing K-12 STEM education system that encourages minority students to engage in studies that can lead to STEM careers and higher education.

IV. FUTURE DEVELOPMENT AND THE CORTEX INNOVATION COMMUNITY'S ONGOING ROLE IN REGIONAL SUCCESS

The Cortex Innovation Community has become a core hub of advanced economic development in the St. Louis region. Its ongoing development as a mixed-use live/work/play/learn environment plays, and will continue to play, a critically important role in the competitive position of St. Louis in the global innovation-driven economy. Cortex has become a well-recognized example of a thriving and expanding innovation district and in many respects, it is seen as an exemplar of innovation district development done right and proceeding with significant momentum.

Cortex management certainly recognizes that its work is not over, and indeed there is considerable future development planned and construction occurring in the District as this report is composed. Economic development is dynamic, and technology-based economic development especially so, and thus the Cortex Innovation Community represents an organization and a physical place that must continue to accommodate change and be strategic in its approach to it. While change is always present, in recent decades the velocity of change has accelerated. Driven by scientific research and the engineering and technology advancements that scientific advancements bring, the world of business has been changing, fast. A series of change forces are impacting regional economies and affecting their prospects for future success. Chief among these forces are three categories of change:

- **Disruptive Technologies** – These comprise technologies that have the potential to create new markets and/or disrupt the position of existing technologies and individual business enterprise. Disruptive technologies have the potential to cause significant changes in the competitive landscape, displace existing businesses, change the geography of production, and demand new skills of the labor force. TEconomy recently classified disruptive technologies for the greater Indianapolis Region, identifying 28 technologies across biological, cyber/digital and physical domains (see sidebar on page 48) likely to represent both significant development opportunities and threats to incumbent businesses and business models. Most, if not all, of the identified disruptive technologies are directly

relevant to companies, research institutions and business sectors operational at Cortex.

- **Convergence** – Represents the accelerating trend whereby traditionally separate industries and businesses respond to identified market needs through collaboration. Business innovation is increasingly occurring at the interface between business sectors (for example between biological sciences and digital sciences, or between robotics and agriculture). Being able to collaborate with leaders from other sectors to integrate multiple technologies and business activities to derive new products and new solutions to market needs is a highly desirable skill set. Companies known for work in one sector may partner with, or acquire entities, in another to develop multicomponent systems and novel combinatorial innovations or services. A key takeaway for Cortex is that the ongoing facilitation of a community with strong collaboration and interfacing opportunities is crucial, and that focus on an individual sector to the exclusion of other fast moving tech sectors may hinder the ability to capitalize on convergence opportunities.
- **Emerging New Business Models and Megatrends** – In part through application of the above two forces, a series of new business models and customer/product delivery models are emerging that create both opportunities for new businesses and business expansions, and threats to incumbent businesses unable to adapt or appropriately respond. Examples include the emergence of a “sharing economy” whereby individuals access assets as needed rather than owning them (e.g. Uber/ ride sharing, electric scooters/bikes, music and entertainment, such as with Spotify). There are many others emerging (such as the gig economy, at-home economy, smart environment, etc.) that represent dynamic opportunities and threats.

Disruptive Technologies

Biological

- Bio-nanotech and Nanomedicine
- Cyber-biological Systems/Implantables
- Gene Editing
- Metabolic Engineering
- Next-Gen Sequencing
- Regenerative Medicine and Tissue Engineering
- Synthetic Biology

Cyber/Digital

- Artificial Intelligence
- Virtual and Augmented Reality
- Cyber Security
- Cloud
- Big Data Analytics and Associative Intelligence
- Natural Language Processing
- Quantum Computing
- Information Validation
- Edge Computing
- Mobile Internet
- The Internet-of-Things
- Blockchain Technology

Physical

- Additive Manufacturing
- Advanced Materials
- Advanced Robotics
- Alternative and Renewable Energy
- Alternative Mass Transit
- Autonomous Vehicles
- Electric Vehicles
- Energy Storage
- Nanotechnology

A place-based, innovation district can be developed to be an ideal environment for capturing opportunities from the forces of change. Cortex is now home to hundreds of technology businesses, including novel start-ups and operations of major established corporations. It is also a “community”, working proactively to build interactions and connections between organizations and individuals well-suited for discussion of disruptive technologies, convergence and new business models.

Based on examining the Cortex ecosystem in action and considering forces of change, TEconomy anticipates that the Cortex Innovation Community would benefit from considering a series of additional initiatives or programs (Table 18):

- “Forces of Change” Events Series
- Facilitated Convergence Discussions
- Open Innovation Collaboratives
- Innovation Attraction Seed-Grant Program
- Reconfigurable “Smart Infrastructure”

Table 18: Potential Additional Initiatives and Programs

Recommended Program	Description	Potential Entities to Engage
1. Forces of Change Event Series	<p>As an “Innovation Community” that is home to a broad variety of companies, technologies and organizations, and adjacent to world class research institutions, Cortex is particularly well positioned host dynamic discussion events focused on disruptive technologies, convergence opportunities and emerging business megatrends. Recent experience in Oklahoma City is that a series of events focused around disruptive tech and forces of change are likely to be very well attended (upwards of 300 people per event), sparking substantial dialog and introducing interested parties to one another. Speakers and round-table events may be developed around specific disruptive technologies (e.g. applications of blockchain, artificial intelligence, next-gen robotics, etc.), and/or focused around convergence themes or megatrends (e.g. digital agriculture, personalized healthcare, the sharing-economy, etc.). The key is to develop events that contain an appropriate mix of informative content, active dialog opportunities, and an ability for networking to occur between participants. With hundreds of companies, spanning a broad variety of tech-spaces, and the expertise of faculty and researchers within regional universities and industry, a series of regular events are likely to see high attendance, help assure leaders understand the opportunities and threats contained in new tech and business models, and, most importantly, connect with one-another to pursue opportunities. By facilitating and hosting a “Forces of Change” event series Cortex can play a key regional convening role, helping regional leaders and industries to understand and navigate convergence and disruption forces.</p>	<ul style="list-style-type: none"> • Cortex • Venture Café • Innovate St. Louis • BioGenerator • WUSTL • SLU • UMSL <p>Audiences: business leaders, university faculty, economic development leadership, key service industries.</p>
2. Facilitated Convergence Discussions	<p>The forces of convergence are creating diverse opportunities, with technology (especially digital technology) being integrated across nearly all business models. In some cases realizing convergence opportunities requires bringing together companies from sectors that have not previously interacted. A notable example of this has been in the emerging field of precision agriculture which has seed companies, agricultural equipment companies and digital big data companies, GPS and mapping companies, converging and collaborating around the opportunity in unique ways. As a community, Cortex can help to strategize where opportunities may exist for convergence based on the characteristics of community companies and engaged R&D organizations. As an initial exercise it may be productive to convene focus group work-sessions of business and research leaders drawn from across multiple sectors to brainstorm on “opportunities in convergence”. Cortex may then select two or three of the most promising convergence opportunity areas to host events around to facilitate interactions between potential parties and spark innovative thinking.</p>	<ul style="list-style-type: none"> • Cortex • Venture Café • Innovate St. Louis • BioGenerator • WUSTL • SLU • UMSL <p>Audiences: Primary audience of Cortex-based companies. Plus additional business leaders, university faculty, economic development leadership, key service industries.</p>

Recommended Program	Description	Potential Entities to Engage
3. Open Innovation Collaboratives	<p>“Open Innovation” is a rising trend for R&D and there are developing models that use major corporate assets and expertise to attract and anchor open innovation activity. A successful example of this is the Stevenage Bioscience Catalyst (SBC), developed in the UK on the GlaxoSmithKline (GSK) corporate campus. The SBC is a public/private development between GSK; the UK Department for Business, Innovation and Skills; the Wellcome Trust; the East of England Development Agency; and the Technology Strategy Board. GSK provided land, facilities, and investment totaling almost £11 million (\$14.7 million) to help build and launch the campus. The SBC provides small to medium-sized biotech and life sciences companies and start-ups with access to the expertise, networks and scientific facilities associated with multinational pharmaceutical companies. The key is bringing researchers’ ideas together with existing industry expertise to accelerate technology evaluation, market analysis and commercialization. An environment has been created at the SBC such that academic researchers from leading UK universities, including Cambridge, are actually relocating to the SBC.</p> <p>The open innovation model is a best-fit to clusters where there are well established business leaders present in the region that are actively engaged in intensive R&D and have specialized infrastructure to facilitate it. Agbioscience is an example in the St. Louis region, with a major Dupont R&D facility directly located at Cortex.</p>	<ul style="list-style-type: none"> • Cortex • Discussions with large regional company R&D operations regarding interest. <p>Audiences: business leaders.</p>
4. Innovation Attraction Seed-Grant Program (like cyclotron road)	<p>Cortex has created a highly effective and attractive environment for incubating and accelerating innovative technologies and business concepts. It does not have to solely rely on the St. Louis region to be the source of entrepreneurial business activity, and there are examples of programs developed elsewhere in the U.S. that are designed to leverage specialized infrastructure and research environments to attract persons with novel innovations and an interest in building a start-up venture. It may be possible to supplement local creativity with flows of novel ideas and innovations from outside of the region via the use of a funding program that would attract entrepreneurial ideas and concepts from outside St. Louis to be further gestated and developed in the Cortex ecosystem. A model for such a program has been successfully deployed by the U.S. Department of Energy National Laboratory System at Lawrence Berkeley National Laboratory (LBNL) in California – it is called “Cyclotron Road.” Cyclotron Road is an innovative program that serves to attract talented inventors (primarily postdocs) and their innovative technologies to LBNL to further their development and proof-of-concept testing toward commercialization. The program operates as a competition, with innovators applying to be participants and those winning entry to the program being embedded at LBNL where they are supported for two-years as they advance their early-stage commercial concepts (supported via a stipend, health insurance, and free access to lab instrumentation and expertise). Effectively operating as a very early-stage accelerator program, this program helps innovators bridge gaps between their concepts and commercialization.</p>	<ul style="list-style-type: none"> • Cortex • WUSTL • SLU • UMSL • City, County and State economic development leadership. <p>Audiences: business leaders, university faculty, economic development leadership, key service industries.</p>

Recommended Program	Description	Potential Entities to Engage
4. Innovation Attraction Seed-Grant Program (like cyclotron road) (cont.)	A similar program may be considered for the Cortex Innovation Community using core ecosystem assets including company and university infrastructure, and expertise as surrogates for the national lab infrastructure used in the Cyclotron Road model. As envisioned, the program would solicit competitive applications for a two-year, stipend-based temporary post-doc position within the adjacent universities for innovators with novel concepts in the clusters. Unlike the program at LBNL, which does not have an incubator, Cortex has the distinct advantage of also having multiple incubator operations and a fully functioning entrepreneurial support ecosystem to assist new start-up ventures stemming from competition winners	
5. Reconfigurable “Smart Infrastructure”	For many technology developers a key roadblock in their development pipeline is access to piloting and testing infrastructure at a scale that can prove and demonstrate their technology’s market and financial viability. This challenge exists across a range of major tech sectors (in the internet-of-things, smart city infrastructure, advanced transportation systems, etc.) where there exists need to pilot technology in physical environments where usability, utility, and application performance can be monitored in real-world, or simulated real-world, conditions. With 200-acres of development, and control over infrastructure and associated projects, Cortex could think outside the box in terms of developing its future physical infrastructure to be conducive to the piloting and testing of smart systems. Ideally, this would incorporate both physical infrastructure such as underground or overhead reconfigurable conduits/tunnels, smart streetscape infrastructure, together with a digital network backbone (wired and wireless) able to connect into a collaborative R&D/control hub. The concept here would effectively leverage Cortex to create a city-within-a-city – a living community-wide laboratory for the development, testing, piloting and demonstration of technologies that need to be tested and demonstrated at scale – thereby attracting technology developers to locate teams at Cortex. Because the ongoing development of the Cortex Innovation Community is envisioned to further build infrastructure for residential, retail, service, business transportation and other functions, the district may be engineered to provide companies and research institutions with the ability to test new technologies and infrastructure across multiple and integrated application areas. Smart health infrastructure and technologies may be a logical area to examine given the profile and R&D strengths of Cortex companies, universities and BJC.	<ul style="list-style-type: none"> • Cortex • Master planning firm consulting with Cortex • City of St. Louis • Regional utility companies <p>Audiences: technology companies seeking to pilot, test and scale technologies requiring reconfigurable smart infrastructure.</p>

Ultimately, Cortex has been successful (and is on the right trajectory to achieve further success) in creating a physical environment and community that fully meets the ideal for an innovation-based economic development ecosystem. In reviewing technologies, trends, and regional characteristics across the country and internationally, TEconomy sees a series of innovation environment characteristics that are important to achieve (bulleted below). Cortex is well-placed, and well on the way, to achieving excellence across most.

- An open and experimental R&D and industry environment.
- Encouragement of, and development of structures that encourage and support for transdisciplinary inquiry.
- Highly networked within and across sectors to facilitate ideation and strategic collaborations.
- Proactive removal of regulatory impediments to the implementation of new technologies.
- Development of open R&D environments able to facilitate the testing, piloting and demonstration of new technologies
- STEM-intensive education from PreK through to the adult workforce.
- State of the art in facilitating the re-skilling and upskilling of labor.
- Development of new infrastructure that is flexible to reconfiguration and integration of new technology demonstrations.
- Global in outlook, connected and export/traded-sector oriented.
- High penetration of renewable energy systems and associated smart energy technology.
- Immigrant friendly and encouraging of diversity.
- Engaged with strong government, education, and community leadership in facilitating change.

V. CONCLUSION

The Cortex Innovation Community has a deserved reputation as an exemplar among the United States growing cadre of innovation districts. Particularly since a restructuring of management in 2010, Cortex has been on a highly successful development trajectory.

Today, with over \$700 million in investment and 2 million square feet of space, Cortex is a dynamic mixed-use environment and the go-to hub for small and large technology-oriented business ventures and institutions in the St. Louis region. The Innovation Community is now home to 369 companies, spanning a diversity of science, technology and innovation sectors, and Cortex benefits from operation of a holistic TBED ecosystem providing access to specialized facilities, infrastructure, expertise, capital and guidance necessary to advance fast-growth enterprise.

The characteristics of the Cortex Innovation Community, as a dynamic hub for innovation and creativity, have now resulted in Cortex being “on the radar screen” of major established companies seeking to place operations in the type of dynamic innovation district environment that Cortex has fostered. By creating an environment favorable to entrepreneurs, to expanding businesses, to innovative operations of large companies, and to universities and R&D performing institutions, Cortex has strategically managed to place itself in the enviable position of being a recognized, signature placemaking initiative that delivers on the type of environment fa-

vored by modern technology enterprises and attractive to the skilled workforce that these industries require.

As home to 5,780 direct jobs, the economic impact of Cortex on regional employment and business output is significant and expanding. TEconomy finds that total economic impact associated with Cortex at the close of 2018 stood at more than \$2.1 billion with a total of 13,152 jobs in the MSA driven by Cortex economic activity. Furthermore, the investment by government, in granting TIF authority and other incentives to development, is paying off. Projections for revenues generated by Cortex-based development and operations over the 30 year projection period point to over \$775 million in TIF generated revenues. TEconomy’s input/output analysis shows almost \$70 million generated in state and local tax revenues in 2018.

All involved in the development of Cortex should be proud of the work accomplished to-date, moreover the region can anticipate many further benefits to come as Cortex helps to cement St. Louis’ position in a highly competitive global economic race for technology jobs and innovation.

APPENDICES

APPENDIX A.

List of Currently Active Investors in Companies Located in the Cortex Innovation Community
(Source: Pitchbook January 2019)

Investor	Active Cortex Investments
BioGenerator	21
Missouri Technology Corporation	15
Accelerate St. Louis	12
Arch Grants	11
St. Louis Arch Angels	10
Cultivation Capital	8
Billiken Angels Network	5
Capital Innovators	4
iSelect Fund	4
Sling Health Network	4
Washington University in St. Louis Endowment	4
Argonautic Ventures	3
Holton Capital Group	3
Plug and Play Tech Center	3
Lord Rothschild	2

Investor	Active Cortex Investments
Pinpoint Holdings	2
Skandalaris Center	2
1517 Fund	1
180 Degree Capital	1
ABC Laboratories	1
Advantage Capital (St. Louis)	1
Alafi Capital Company	1
Ameren Accelerator	1
Apjohn Ventures	1
Arsenal Capital Management	1
Ashby Point Capital	1
Atlas Venture	1
Axia Ventures	1
Belle Capital	1
Bill Donius	1
Bill Schmidt	1

Investor	Active Cortex Investments
BIRD Foundation	1
Black Beret Life Sciences	1
Bold Capital Partners	1
BPEA Private Equity	1
Broadview Ventures	1
C3 Capital	1
Centennial Investors	1
Charter Life Sciences	1
Children's Discovery Institute	1
Cleantech Open Midwest	1
Correlation Ventures	1
Cygnus Capital	1
DALI+DEN Pitch	1
Donald Dodge	1
Dorm Room Fund	1
DreamIt Ventures	1
Fast Forward at Johns Hopkins University	1
F-Prime Capital Partners	1
Frameshift (Missouri)	1
GCM Grosvenor	1
Great Lakes Entrepreneurs Quest	1
Grey Sky Venture Partners	1
GVA Capital	1
HBM Healthcare Investments	1

Investor	Active Cortex Investments
HBM Partners	1
HealthX Ventures	1
Heartland Angels	1
Helix Center Biotech Incubator	1
Huron Capital Partners	1
Jewish Federation of St. Louis	1
JLABS	1
Kingdom Capital	1
Kingfish Group	1
Kinsale Capital Partners	1
Lux Capital	1
Massachusetts Institute of Technology	1
MassChallenge	1
MB Venture Partners	1
Neotribe Ventures	1
New Enterprise Associates	1
Nokia	1
North Carolina Biotechnology Center	1
Oakland Capital Partners	1
Olin Cup	1
Oncolys BioPharma	1
Orchard Venture Partners	1
Pat Steinlage	1
PEI Funds	1

Investor	Active Cortex Investments
Peter Diamandis	1
Prolog Ventures	1
Prosper Women Entrepreneurs	1
Qiming Venture Partners	1
RiverVest Venture Partners	1
Saint Louis University Endowment	1
Serra Ventures	1
SPIE Startup Challenge	1
Springboard Enterprises	1
Springfield Angel Network	1
Springfield Investments	1
St. Louis Economic Development Partnership	1
Startup Connection	1
StartUp Health	1
Startupbootcamp	1
Steve Thomas	1
Tech Coast Angels	1
TechCrunch	1
The Lambda Funds	1
The LAUNCH Incubator	1
The Mobileys	1
Triathlon Medical Ventures	1
Twin Cities Angels	1
University of Washington	1

Investor	Active Cortex Investments
Warson Capital Partners	1
Wharton Venture Initiation Program	1
Yield Lab	1

APPENDIX B.

Cortex Board of Directors Inclusion Committee – Purpose and Focus.

Plus example forms used for evaluating development and use equity.

Cortex Board of Directors Inclusion Committee

Purpose

The Inclusion Committee (“Committee”) is a standing committee of the Board of Directors (“Board”). The purpose of the Committee is to assist in developing a comprehensive inclusion strategy for the Cortex Innovation Community and aligning that plan with the District’s annual strategic real estate, employment and programming goals in order to distinguish Cortex as a model for inclusion and equity practices in innovation communities.

Membership

Initially, membership shall consist of six (6) members related to the Cortex Board of Directors (members, directors and guests) and no less than four (4) non-board related members, as well as staff representatives. Any recommended changes of committee membership, whether to the initial committee appointments the total number of committee members or additional classes of membership, shall be approved by the Executive Committee of the Cortex Board of Directors. All Committee members are expected to attend an anti-bias / anti-racism training workshop within the first four months of their addition to the Committee, if they have not attended a workshop previously.

Duties and Responsibilities

- Drafting a Cortex statement that defines our vision and commitment to inclusion and equity in the District.
- Conducting a baseline audit of Cortex’s culture, language, definitions, behaviors and activities related to inclusion and equity. The audit will be reviewed and updated every two years, or as determined by the Committee.
- Developing goals and implementing a strategy to achieve that vision, including but not limited to:
 - Defining Cortex’s equity lenses for decision making, programs, and policies, with a focus on race/ethnicity and gender equity and including those reflecting foreign-born/immigrant, ability, cultural background, sexuality, and socioeconomic status/class,
 - Establishing clear, measurable goals and identifying the responsible parties for implementation,
 - Creating a process to measure and evaluate progress, and
 - Providing District tenants with a community of practice to support their own inclusion and equity work.
- Identifying inclusion and equity training opportunities for Board and staff.
- Identifying opportunities to be in relationship and dialogue with regional leaders involved in inclusion and equity work.
- Working with other Board committees to integrate inclusion and equity practices into Cortex projects, programs, and leadership.

- Engaging with tenant companies in data collection and sharing and partnering with them in framing and achieving inclusion and equity goals.
- Making Cortex's inclusion and equity plan and progress toward specific goals known and accessible to the public.
- Reviewing best practices in inclusion and equity work nationally, both in urban innovation communities and in the corporate community.
- Evaluating the Ferguson Report's Signature Priorities and Calls to Action and The Promise Zone's five goals to determine how Cortex might undertake actions that align with these initiatives.

Accountability

The Committee's mission, goals and progress will be published on the Cortex website and updated regularly.

Meetings

The committee will meet a minimum of four (4) times annually.

Reporting

The committee chair will report to the Board at its quarterly meetings.

Example Form: Cortex Real Estate Development Equity Assessment

Project Name	
Location	
Developer	
Year of Completion	

Construction Assessments:

Assessment Area	Answer	Notes
Is the project owner/developer a minority or women-owned business (M/WBE)?		
Has the developer used good faith efforts to meet or exceed City and County construction enterprise goals?*		
Has the developer used good faith efforts to meet or exceed City and County workforce participation construction goals?*		
What is the rate of participation by minority and women-owned enterprises in providing professional services (e.g. design, architecture, engineering) to the development?		
Will/does the project receive any subsidy or abatement? What kind?		

** City of St. Louis established construction diversity goals in 2009 with passage of city ordinance 68412. Goals were updated through amended executive order 28. St. Louis County established construction diversity goals in 2014 with an executive order based on legislative bills 109, 110, 111.*

Example Form: Cortex Real Estate Development Equity Assessment

Project Name	
Location	
Developer	
Year of Completion	

Use Assessments:

Assessment Area	Answer	Notes
What is the rent/lease rate/cost for use of the space?		
Who is the target market of this project, according to the developer?		
Does the development include a community benefit component of any kind, or provide any civic or district resource?		
How does the physical space and intended use of the development promote equity and/or inclusion? <ul style="list-style-type: none">• Does the development include gender-neutral restrooms?• Does the development include a nursing/ mother's room?• Is building signage understandable to people who communicate in ways other than written English?• Does the development go above and beyond the required features for ADA compliance?		

