

# Measuring the Economic Impact of Community College Innovation

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*Community College Contract Service Organizations' Contributions to Economic Growth*

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## Abstract

Contract Service Organizations (CSOs) within American community colleges have existed for over 10 years, most with initial funding provided by grants from the National Science Foundation's Advanced Technological Education program. This innovative approach to work experience for students in career and technical education programs also creates a positive economic impact in the cities in which they are located. Since community colleges are not only educational institutions, but also are involved in community outreach and service, community college CSOs provide a distinct advantage for economic growth in the cities in which they are located. This article illustrates how St. Louis Community College and its CSO, the BioBench, have played a vital role in the growth of the St. Louis metropolitan region's technical and life science economic expansion and how its **\$127 Million positive economic impact** can be measured and sustained.

## High Tech Job Growth in St. Louis

St. Louis, Missouri was named the fastest growing city in the country for tech jobs by CNN Money<sup>1</sup>. This claim came originally from [Dice.com](http://dice.com)<sup>2</sup>, a website for tech news and career advice, which uses percent change in tech jobs from year to year to gauge growth. Both Dice and CNN Money describe how the support of start-ups, courting of large employers and the funding of Science, Technology, Engineering and Mathematics (STEM) education initiatives, all make St. Louis a number-one startup city. The support which St. Louis entrepreneurial networks give, along with the amount of expanding venture capital in St. Louis – over \$1 billion since 2001 – all contribute to this growth. Entrepreneurial incubators such as the Center for Emerging Technologies, BioGenerator at the Center of Research Technology and Entrepreneurial Exchange (CORTEX), Bio Research and Development Growth (BRDG) Park, Helix Center and others are indicators that much of the technology growth in St. Louis is fueled by plant and life science research and development.

## St. Louis' Biotech Growth

The seeds for the St. Louis biotech boom began as early as 1998 when three key St. Louis leaders recognized a perfect confluence of key ingredients for growth in plant and life sciences: the geographic location in the nation's cropland; an abundance of scientific research institutions, including Washington University in St. Louis

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<sup>1</sup> *Fastest growing cities for tech jobs*, Anne Fisher @ FortuneMagazine; March 20, 2013; CNN Money; <http://money.cnn.com/gallery/pf/jobs/2013/03/20/best-cities-tech-jobs.fortune/2.html>

<sup>2</sup> Dice: The Career Hub for Tech, March 2013; <http://media.dice.com/report/march-2013-tech-hubs-redefined/>

and St. Louis University; and many successful scientific companies such as Monsanto, Sigma-Aldrich, Covidien-Mallinckrodt and Pfizer. Dr. William Danforth, chancellor emeritus of Washington University in St. Louis; Peter Raven, director of the Missouri Botanical Garden; and Virginia Weldon, retired senior vice president of public policy for Monsanto St. Louis began planning for what later would be referred to as “The BioBelt.”<sup>3</sup> A first step was to recruit Dr. Robert Calcaterra to head the Nidus Center for Scientific Enterprise – the first biotech incubator in the St. Louis region. Another important step was the founding of the Donald Danforth Plant Science Center (Danforth Center) in 1998. The Danforth Center was financed by grants from the Danforth Foundation, the Monsanto Fund, Monsanto Company and tax credits from the State of Missouri.<sup>4</sup> The St. Louis Regional Council and Growth Association (RCGA, currently the St. Louis Regional Chamber) commissioned a study by the Battelle Memorial Institute that resulted in a report in 2000 with recommendations for further growth. The Coalition for Plant and Life Sciences (Coalition), a broad-based civic organization of top business, science, academic and philanthropic leaders was formed by Dr. William Danforth in 2001. This coalition facilitated the creation of new bioscience and medical discoveries and companies arising from St. Louis research institutions. Necessary capital, space and business support was provided by the Coalition to sustain new startups. A follow-up Battelle study in 2005 confirmed that St. Louis’ implementation of their strategic plan and vision had resulted in more progress than any other region of the country in the area of life sciences.<sup>5</sup> Several early stage investors, including the BioGenerator, the Billiken Angels and the Arch Angels were formed to create an even more robust startup environment. Since 2005, the Angels alone invested over \$31.5 million into 37 companies, almost 60% of which operate in the biosciences.<sup>6</sup> The Coalition evolved to become BioSTL in 2011 and it continues to maintain the vision of continued growth in plant and life science research and commercialization in St. Louis. The goal of BioSTL is to increase the region’s capacity to support entrepreneurs in the medical and plant biosciences over the next 10 years, 2011 - 2021.<sup>7</sup>

## STLCC Biotechnology Program

The leadership at St. Louis Community College (STLCC) has played a role in the growth of the biotech infrastructure in St. Louis since 1996. Under the leadership of Dr. Irving McPhail, President of the Florissant Valley campus of STLCC, Eilene Lyons arranged the first technical scan of local life science companies. Technical scans are the first step in determining if new career and technical programs are necessary. This scan explored whether jobs in biotechnology were available, what basic skills were necessary for biotechnicians, and whether there existed the possibility of internships in this emerging STEM field in the St. Louis region. The consensus was not entirely positive, so plans were placed on hold. In 1998, another tech scan was conducted at the urging of 1996 technical scan attendees; this time, the forecast was positive for internships and jobs and a DACUM<sup>8</sup> was conducted. In 1999 the Biotechnology AAS program began as did the college’s hiring of a project associate, Dr. Richard Norris. Dr. Norris forged strategic alliances with the Nidus Center, the Danforth Center and the members of the Coalition for Plant and Life Sciences. STLCC was one of the founding members of the Missouri

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<sup>3</sup> *Building a Biobelt*, Janni Simner, 2001; <http://magazine-archives.wustl.edu/Winter01/Calcaterra.html>

<sup>4</sup> DDPSC Website; [http://www.danforthcenter.org/the\\_center/about\\_us/history.asp](http://www.danforthcenter.org/the_center/about_us/history.asp)

<sup>5</sup> St. Louis Regional Chamber Website, Plant and Life Science page; <http://www.stlrcga.org/x1734.xml>

<sup>6</sup> BioSTL: Advancing St. Louis Bioscience; Newsletter Volume 6, April 2013; <http://biostl.org/news/volume-6-april-2013/>

<sup>7</sup> BioSTL: Advancing St. Louis Bioscience; About Us; <http://biostl.org/about/>

<sup>8</sup> DACUM is an acronym for Developing a Curriculum by using a focus group in a facilitated storyboarding process to capture major duties and related tasks included in an occupation

Biotechnology Industry Organization (MOBIO) and STLCC-FV President Dr. Marcia Pfeiffer served on the first MOBIO Board of Directors. Due to its many strategic alliances, members of the STLCC Biotechnology program staff were interviewed by the Battelle Institute in their first study commissioned by the RCGA in 2000. An important reference to the community college was included in the Battelle study:

*“Continue to develop and expand career opportunities with community college and vocational partnerships, such as vocational education/community college 2+2 programs, with special outreach to inner-city minority youth.”<sup>9</sup>*

The timing of the formation of the biotechnology program at STLCC was crucial for the expansion of the skilled workforce that would be needed as biotech investment and infrastructure began to build in St. Louis.

### STLCC at BRDG Park at the Danforth Center

The Danforth Center was completed in 2001. Its mission is to “Improve the Human Condition through Plant Science.” This mission has three pillars: 1) Feed the hungry and improve human health; 2) Preserve and renew our environment; and 3) Enhance the St. Louis region as a world center for plant science. This third pillar in the mission resulted in the Danforth Center’s commitment to expand bioscience research by dedicating eight acres of the campus to commercial wet lab space for small companies and related activities.<sup>10</sup> Wexford Science + Technology LLC invested in the development of the Bio-Research & Development Growth Park (BRDG Park). While BRDG Park was in the planning stages, the 2005 Battelle report stated,

*“As the region’s start-up companies expand, there is likely to be greater demand for technicians than can be produced currently. An option that might be considered to enable STLCC to expand their biotechnology offerings would be to provide lab space for the college in the new multi-tenant building being planned...<sup>11</sup>”*

Once again, the community college was at the forefront of the expansion of biotech in St. Louis. STLCC’s response was to form a new Center of Excellence to provide advanced technology training in plant and life sciences – the Center for Plant and Life Sciences (CPLS). The CPLS was charged with enhancing several college programs at STLCC, including Biotechnology, Horticulture, and Clinical Laboratory Technology. The College’s laboratory space at BRDG Park would be used for teaching laboratory courses of the Biotechnology AAS Program. The College’s Board of Trustees approved a fifteen year lease of 10,500 square feet on the first floor of BRDG Park in 2009. Through Missouri State tax credits plus initiatives and help from Wexford Science + Technology LLC, Monsanto, and grant funding, the CPLS came into existence with the college funding 42 percent of the \$1.8 million build-out cost. This center is a national model for addressing the skilled workforce needs of a region by embedding education and training within an incubator for small plant and life science companies. The financial and economic acumen of the leadership of the college, along with that of the Danforth Center, Wexford Science + Technology LLC, Monsanto and the State of Missouri made this possible.

In 2013, a new Bridge to STEM-Life Science project created the Life Science Laboratory Assistant program (LSLA)

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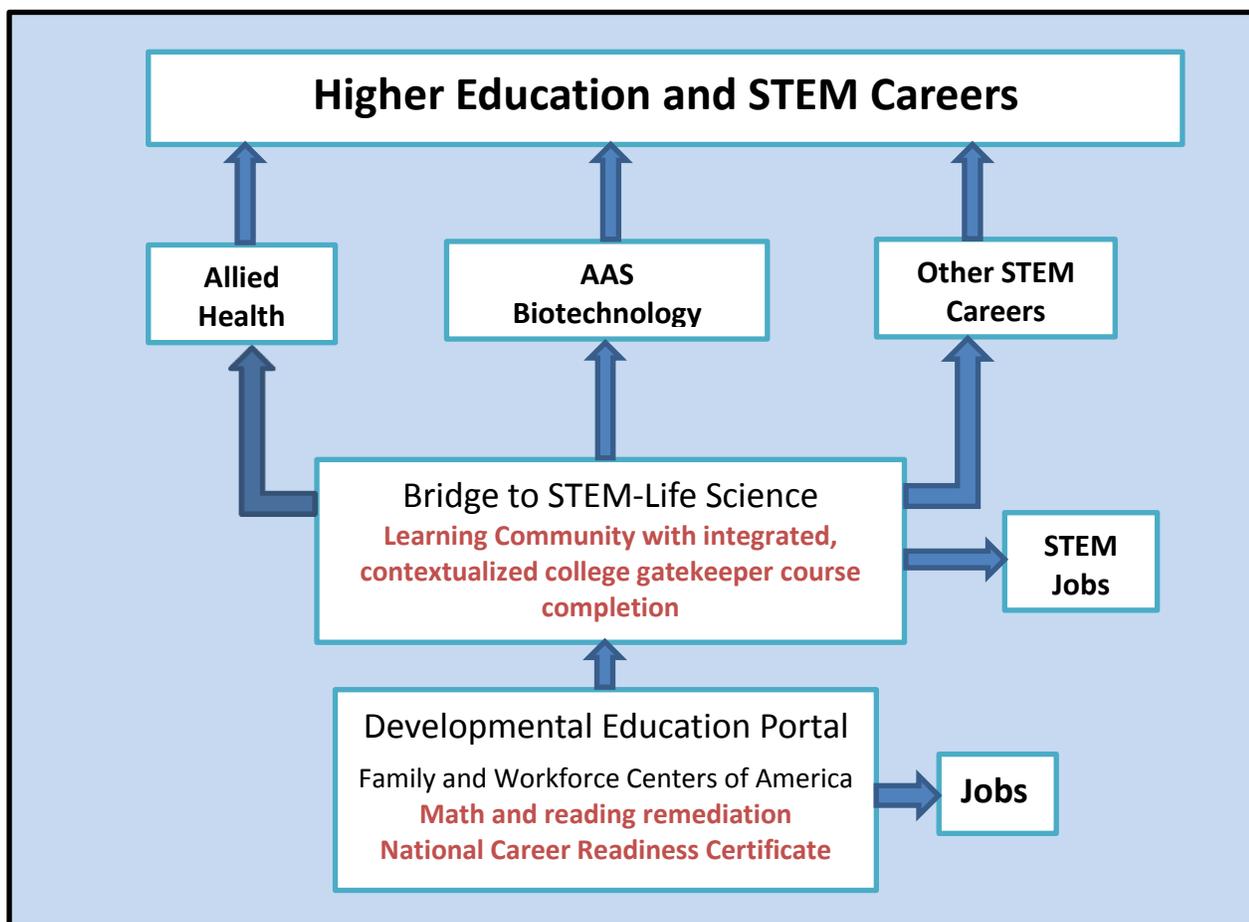
<sup>9</sup> *Plant and Life Sciences Strategies for St. Louis: The Technology Gateway for the 21st Century*, prepared for the St. Louis Regional Chamber and Growth Association by The Battelle Memorial Institute, September 2000

<sup>10</sup> Donald Danforth Plant Science Center website; [http://www.danforthcenter.org/the\\_center/brdg\\_park/](http://www.danforthcenter.org/the_center/brdg_park/)

<sup>11</sup> *St. Louis Plant and Life Science Strategic Update and Action Plan*, prepared by Technology Partnership Practice, Battelle, January 2005

at the CPLS. This short term training program is in part the result of a federally funded stimulus grant administered by the Missouri Department of Economic Development called *Training for Tomorrow* and an NSF synergy grant. Through Eilene Lyons' connection to Bio-Link<sup>12</sup> *The Synergy Bridge to Biotech* project grant was used to disseminate to other community colleges the successful ramp-up to the biotechnology program at City College of San Francisco. This new STLCC program addressed the unemployment in the city of St. Louis by offering a 16 college credit hour Certificate of Specialization to mostly underrepresented and unemployed citizens needing developmental precollege remediation. The innovative curriculum includes contextualized developmental reading and mathematics courses taken concurrently with college level science gatekeeper courses leading to the Biotechnology AAS, other STEM and allied health programs as well as basic entry level job skills in bioscience. Graduates can go to work immediately as laboratory assistants and/ or continue their college education. The LSLA program is an important part of the pathway to STEM education in St. Louis (**Figure 1**).

**Figure 1. The STLCC STEM Career Pathway**



<sup>12</sup> **Bio-Link**, a National Advanced Technology Education Center of Excellence focused on Biotechnology and Life Sciences, funded by the National Science Foundation, Division of Undergraduate Education [www.Bio-Link.org](http://www.Bio-Link.org)

## STLCC BioBench Contract Research Organization

The CPLS is also the site of the BioBench Contract Research Organization (CRO), a type of Contract Service Organization (CSO), funded by an Advance Technology Education (ATE) project grant from the NSF. Community college biotechnology programs and contract organizations can take various forms, depending upon the local industry. The St. Louis Community College Biotechnology program is research and development (R&D) based, due to the abundance of university research and R&D at medical and bioscience companies in St. Louis. The BioBench is an R&D-based contract research organization<sup>13</sup> (CRO). Typical research CRO's handle clinical trials for pharmaceutical companies, but the BioBench CRO takes in basic biotech research projects requiring cellular-molecular and plant science expertise. Its location within the College's Center for Plant and Life Sciences at BRDG Park at the Danforth Center has allowed the BioBench to be intricately involved in the growth of mid-level and beginning start-up companies within this bioscience incubator. The NSF ATE grant originally funded a Senior Research Scientist, Elizabeth Boedeker, who is now sustained by the college. The Senior Research Scientist reviews possible projects and completes legal contracts with BRDG Park companies, established larger companies, and educational institutions such as Washington University in St. Louis. Contracts can be of three types: 1) projects completed by Biotechnology Program interns paid with grant funding and under the supervision of the Senior Research Scientist; 2) projects completed by Biotechnology Program interns who work at the company within BRDG Park; and 3) companies which use the state-of-the-art equipment and/ or space at the BioBench. There are currently 18 companies at BRDG Park within Building 1, which is at 90% capacity. Ground breaking for buildings 2 and 3 is planned and as they fill, other projects from new companies will be taken on by the BioBench. In addition, entrepreneurs at the Helix Center start-up incubator, located less than a mile from BRDG Park, are currently working with the BioBench to secure contracts for equipment and interns. In the first three and one half years that the BioBench was operational, 16 collaborative companies contracted with the CRO; 32 STLCC interns were employed; 4 graduate interns continued their education at universities; and 19 STLCC intern graduates were hired by companies within BRDG Park, the research laboratories at the Danforth Center and other life science companies in the St. Louis region. Horticulture and Engineering Science students, as well as Biotechnology program students, have interned in the BioBench CRO. The placement of interns in life science jobs and/ or four-year degree programs at articulating higher education institutions is currently 100 percent. High school students also have completed internships at the BioBench during academic years and summers. All interns learn first-hand the importance of deadlines and proper data collection and documentation, reinforcing the laboratory skills and techniques they learn in hands-on classes and structured training sessions.

It is also noteworthy that Wexford Science + Technology LLC markets the BioBench and the skilled workforce coming from the programs at STLCC's Center for Plant and Life Sciences at BRDG Park as a means of attracting tenants. The promise of a skilled workforce at BRDG Park has attracted companies not only from other cities in the U.S. but also from other countries. The positive effect that a ready workforce has on attracting tenants to BRDG Park has led Wexford Science + Technology LLC to partner with community colleges in Boston and Miami to embed similar programs into incubators they are currently building.

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<sup>13</sup> *BIO-Link Summit Report: A summit on Contract Organizations* (2012), funded by the National Science Foundation; <https://www.bio-link.org/home2/publication/bio-link-cxo-summit-report-2012>

## Measuring CRO Economic Impact

Measuring the economic impact the BioBench CRO has had in the St. Louis region requires extensive data gathering, some of which was completed by Jeffery Forrest's fall 2012 students in *Introduction to Economics*, which is part of the Accelerated Learning Program at STLCC-Florissant Valley. First considered are the biotechnology, life science, engineering and horticultural students who have worked as BioBench CRO interns. They have reaped the benefits of on-the-job training as they became employed first as interns earning a competitive wage and then as technicians in permanent, newly-formed full-time positions in successful start-up companies. The stellar placement rate<sup>14</sup> of these biotechnology interns into bioscience technician positions and/ or articulation to higher education attests to the excellent preparation they receive. Consider the unemployment rates of the United States and Missouri as compared to BioBench intern graduates.

United States Unemployment Rate <sup>15</sup> :	7.6% (2013)	5.7% (2015)
Missouri Unemployment Rate <sup>16</sup> :	6.8% (2013)	5.4% (2015)
BioBench CRO Graduate Intern Unemployment Rate <sup>17</sup> :	0% (inception through 2015)	

The measurement of economic impact requires information about the combined direct spending by companies as well as the indirect and induced effects of re-spending, or the number of times a dollar spent will recirculate in the economy -- an economic phenomenon known as the Multiplier Effect.<sup>18</sup> Measuring the *direct impact* of the BioBench includes the following data: 1) spending by the College for build-out and rent at BRDG Park; 2) utility cost; 3) equipment cost; and 4) employee compensation. Based on these cost elements, for every dollar spent by the CPLS, \$11.23 is generated in the form of potential economic growth for the region (**Figure 2, Table 1**). The total expense of STLCC at BRDG Park to date has been \$2.44 million (of which 9.2 percent was funded by NSF and NASA grants). The *direct impact* of STLCC's innovative endeavor of the Center for Plant and Life Sciences and the BioBench CRO has been \$27.4 million for the St. Louis region.

The positive direct economic impact of the spending by STLCC at BRDG Park is enhanced by a chain reaction of indirect and induced spending which starts when new intern graduates become working biotechnicians. *Indirect impact* is due to such employees spending a portion of their increased earnings, making more money available to businesses where the money is spent. When these businesses and their employees in turn increase their spending, there is a positive *Induced impact*. A cycle of economic activity occurs: from biotechnician to grocery store clerk, to produce provider, to produce grower (**Figure 3**). The cumulative change in spending can be calculated by using a multiplier: the multiple by which an initial change in aggregate spending will alter total expenditure after an infinite number of spending cycles, all initiated by an initial spending stimulus.<sup>19</sup>

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<sup>14</sup> As of 2015

<sup>15</sup> Bureau of Labor Statistics ([www.bls.gov](http://www.bls.gov))

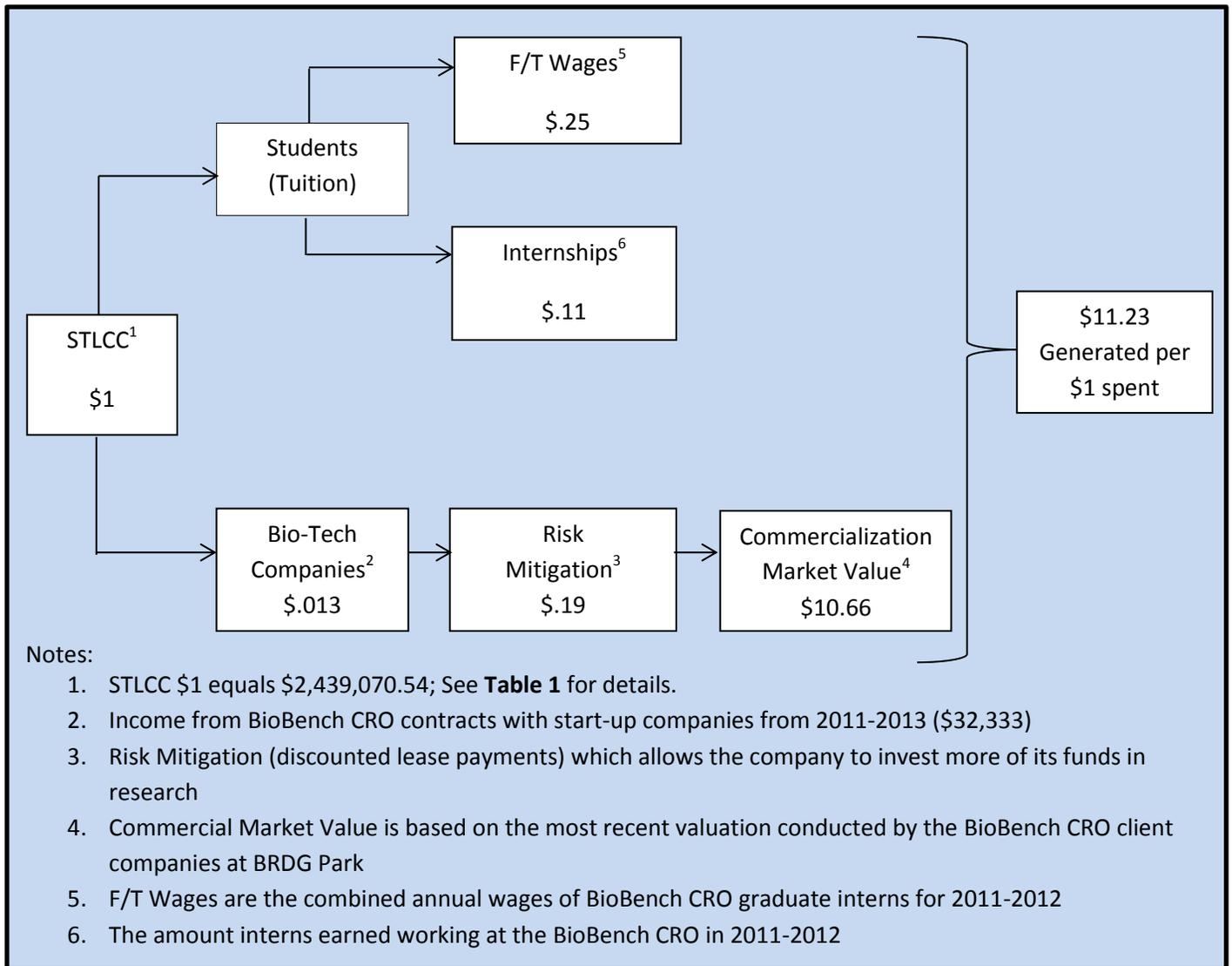
<sup>16</sup> *ibid*

<sup>17</sup> BioBench CRO Intern Job Placement Data 2015; n=62; does not include 2 graduates with whom contact was lost

<sup>18</sup> McConnell, Brue, and Flynn *Macroeconomics*, 18<sup>th</sup> Edition, New York, McGraw-Hill, 2009

<sup>19</sup> Bradley R Schiller, *Essentials of Economics*, 8th edition, McGraw-Hill Irwin 2011

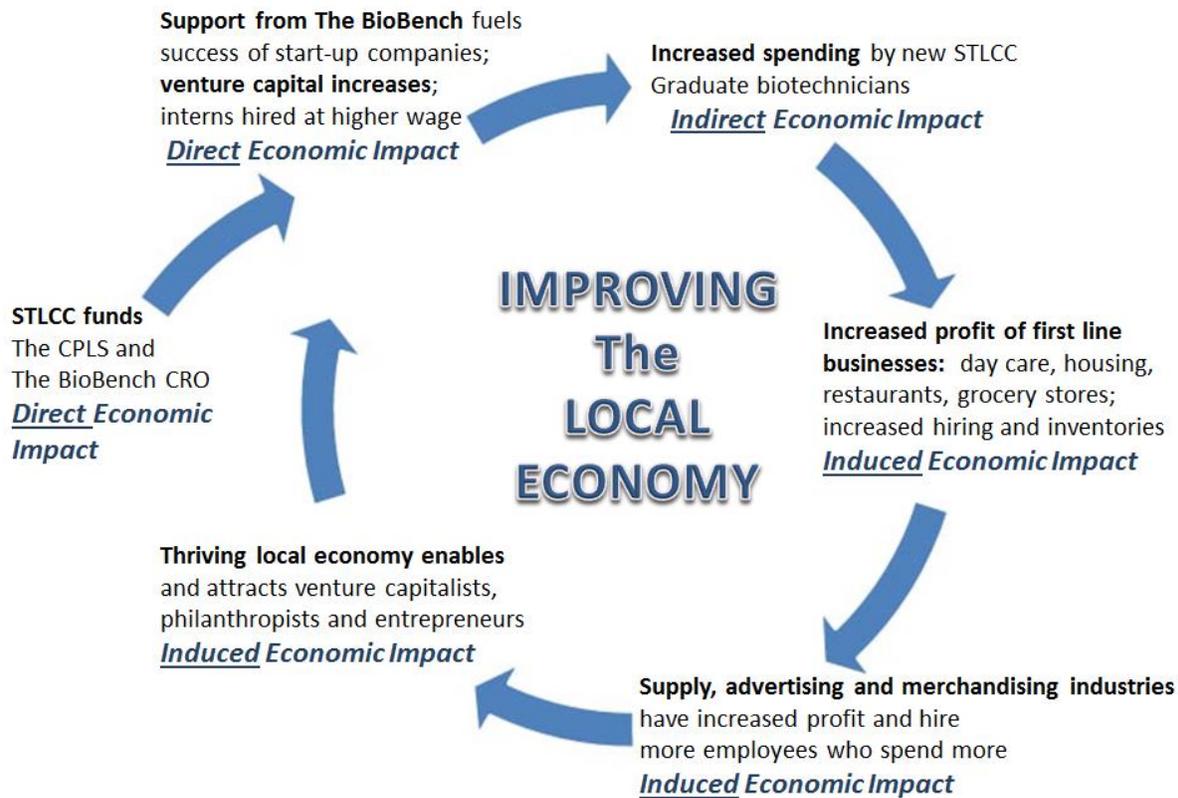
**Figure 2. St. Louis Community College BioBench CRO Potential Economic Impact for the St. Louis Region**



**Table 1. CPLS at BRDG Park Investment Analysis**

Total STLCC investment in BRDG Park	Cost
Net Build-Out Cost (2009)	\$ 750,000.00
Equipment (funded by NASA grants)	\$ 88,290.50
Supplies	\$ 12,686.00
Utilities	\$ 68,400.00
Housekeeping	\$ 3,900.00
Employee Compensation 2010-2012	\$ 703,835.04
Lease Payments (2010-2012)	\$ 674,835.00
Labor Interns 2011-2012 (funded by NSF grants)	\$ 137,124.00
<b>Total Cost</b>	<b>\$ 2,439,070.54</b>

**Figure 3. Initial Spending Stimulus Creates a Positive Economic Impact**



Calculating the indirect and induced impact involves first considering the increase in wages for a typical BioBench intern earning anywhere from \$5 to \$10 per hour more than what he or she earned in a non-STEM, unskilled occupation. This difference in disposable personal income is termed the *Total Wage Differential*<sup>20</sup> and for a typical BioBench intern, this differential is \$5.21 per hour (**Table 2**). When the graduate intern is employed as a biotechnician, the differential is \$10.76 per hour. The Multiplier Effect on the economy can be measured by estimating the marginal propensity to consume (MPC) some of the increase in earnings. If biotechnicians spend 80 percent of their wage differential, then the multiplier used to calculate the economic impact is 5. The change in disposable personal income is multiplied by 5 to calculate the estimated change in the economy over a period of time. Using a multiplier of 5, each BioBench intern’s positive economic effect on the economy as a full time biotechnician for 10 years is more than \$1.1 million. In reality, a multiplier of 5 is conservative. In a poll of current BioBench interns, the average amount being spent is 86 percent. They pay rent, car expenses, child care, health care and more, all of which take a toll on the ability to save while increasing the economic impact due to their increased spending. Therefore, the more accurate multiplier is 7, and the estimated boost to the local economy over ten years would be over \$1.5 million per BioBench intern now working as a biotechnician.

<sup>20</sup> McConnell, Brue, and Flynn *Macroeconomics*, 18<sup>th</sup> Edition, New York, McGraw-Hill, 2009

**Table 2. BioBench CRO Economic Impact: Wage Differential Analysis (10-year horizon)**

Internship:

Retail Clerk: \$10.12<sup>1</sup>/hour

BioBench CRO Internship: \$15.33<sup>2</sup>/hour

Differential: \$5.21/hour

Total Internship Hours provided to date at BRDG Park: 8,479 hours

Total Wage Differential: \$44,176

Estimated Marginal Propensity to Consume (MPC): 80%

Estimated Marginal Propensity to Save (MPS): 20%

Estimated Multiplier<sup>3</sup>: 5

Estimated Change in the Economy: \$44,176 \* 5 = \$220,880

Full-Time Placement:

Retail Clerk: \$10.12<sup>1</sup>/hour

BioBench Intern Graduate salary: \$20.88<sup>2</sup>/hour

Differential: \$10.76/ hour

Total full time hours in one year: 2,080

Total Wage Differential: \$22,381

Number of years of F/T Placement through BRDG Park: 10 years

Economic Impact of 10 years of F/T Placement: \$223,810

Estimated Marginal Propensity to Consume (MPC): 80%

Estimated Marginal Propensity to Save (MPS): 20%

Estimated Economic Multiplier<sup>3</sup>: 5

Estimated Change in the Economy for one intern graduate for 10 years: \$223,810 \* 5= \$1,119,050

1. Salary.com website; [www.salary.com](http://www.salary.com)
2. Data from BioBench intern and intern graduate interviews
3. Multiplier =  $1/1 - \text{MPC}$ ; Bradley R Schiller, *Essentials of Economics*, 8th edition, McGraw-Hill Irwin 2011

As of the 5-year anniversary of the CPLS and BioBench CRO in 2014 there were 56 BioBench interns placed into biotechnician positions, all experiencing higher wage differentials. With two new BRDG Park incubators coming on board and the current inquiries for contracts and internships from start-ups at the new Helix Center, internships and placements are expected to increase. Enrollment is increasing in the program, so another 50 intern graduate placements by 2019 (the ten year anniversary of the opening of The BioBench CRO) is conservative. However, if a minimum of 100 students complete BioBench internships and obtain positions as biotechnicians in St. Louis, using a conservative multiplier of 5, the 10 year projected indirect impact to the St. Louis economy will be over \$100 million dollars. Combined with the \$27.4 million in direct economic impact, STLCC's innovative decision to create the CPLS and the BioBench CRO will boost the St. Louis economy by over \$127 million.

## Sustaining CRO Economic Impact

The prospect for continued economic growth in the St. Louis region hinges on high technology expansion and innovation. The unemployment rate will continue to fall as more investment flows into new ventures and companies are drawn to St. Louis by the technology boom. On the horizon is a rebirth in manufacturing – advanced manufacturing – in St. Louis. St. Louis Community College is even now creating another facet of the BioBench – a CRO at the Emerson Center for Engineering and Advanced Manufacturing at the Florissant Valley campus. Entrepreneurs with proof of concept will be able to use high tech precision manufacturing equipment, 3-D printers and employ engineering interns to create their products. What is good for the economy is not entirely good for higher education, however. When the economy is good, enrollment drops because more people are working and satisfied with their earnings. In addition, demographics show a continued decrease in high school graduates over at least the next three years in the St. Louis region. The decline in real estate values results in less money for education and less funding from state and local governments. It is and will continue to be a difficult few years for higher education institutions. What this means for the BioBench is an invigorated emphasis on sustainability. As of 2015, BioBench CRO income is being used to help pay intern wages and to help purchase supplies. In addition, new innovative perspectives and strategies to garner grant funding are being proposed, not just for the BioBench directly, but for funding to start-up companies that wish to contract with the BioBench CRO.

If venture capital entities, local government economic councils and chambers, and BioSTL in their support of entrepreneurs in the medical, plant biosciences and advanced manufacturing over the next 10 years will build in mechanisms to contract with higher education and employ STEM interns, it would be another innovative step in keeping St. Louis economic development growing. Designated giving as endowments to the STLCC Foundation would be another way to ensure the sustainability of the BioBench and other innovations of the Community College. Partnerships between the many higher education institutions in the St. Louis region and STLCC to build synergistic bridges between STEM programs and the College's successful venture into contract research at BRDG Park are also being discussed. As we all work together, the prospect for continued success is assured.

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\*Eilene M. Lyons was the STLCC-FV founding Biotechnology Program Coordinator, Biology Department Chair and was Acting Dean STEM Division until her retirement in 2013. She serves on the STLCC Biotechnology Program Advisory Committee and is co-author of the popular biotechnology textbook *Biotechnology: DNA to Protein – A Laboratory Project in Molecular Biology* (McGraw-Hill Science/Engineering/Math, ASIN: B014S2Y1IC 0). Eilene is a consultant for **Bio-Link**, a National Advanced Technology Education Center of Excellence focused on Biotechnology and Life Sciences, [www.Bio-Link.org](http://www.Bio-Link.org). She owns her own business, **Lyons Bio Educational Consultants, LLC**. [ELyons0507@gmail.com](mailto:ELyons0507@gmail.com).

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