CLOSING THE GAP:

THE UNIVERSITY CITY SCIENCE CENTER'S QED PROOF-OF-CONCEPT PROGRAM

THIS REPORT WAS PREPARED FOR THE UNIVERSITY CITY SCIENCE CENTER BY THE ECONOMY LEAGUE OF GREATER PHILADELPHIA.

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Founded in 1963 as the nation's first urban research park, the University City Science Center is a dynamic hub for innovation, entrepreneurship and technology commercialization. For more than 50 years, we have helped scientists, entrepreneurs, startups, and growing and established companies throughout the Greater Philadelphia region as they move their technologies into the marketplace, where they can benefit the world. For more information about the Science Center, go to *sciencecenter.org.*

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The Economy League is a civic catalyst that brings together leaders and organizations to address the most challenging issues facing Greater Philadelphia. Built on our foundation of independent, high-quality analysis and practical insight, we spark new ideas, develop strategies, and galvanize action to enhance the region's global competitiveness. Learn more at *economyleague.org.*

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EXECUTIVE SUMMARY

The University City Science Center's QED proof-of-concept program provides business development support and critical funding for academic researchers developing early-stage life sciences and healthcare IT technologies with high commercial potential. The program's primary goal is to reduce commercialization risk in early-stage projects, thus increasing their attractiveness to established companies and private investors.

QED was created to help address a specific gap within the commercialization of life sciences research: a persistent shortage of technical proof-of-concept funding that enables scientists to transition technologies from "discovery" to "development." To help address this challenge, QED provides support to life sciences technologies that have already generated bench data, and assists with the development of pre-clinical or early clinical data to advance these projects along the commercialization pipeline.

QED works with 21 academic and research institutions across three states, embracing a regional approach to proof-of-concept funding that identifies and supports promising projects across large and small universities, research hospitals, and life sciences research institutes. It is one of the nation's first multi-institutional proof-of-concept programs focusing on life sciences.

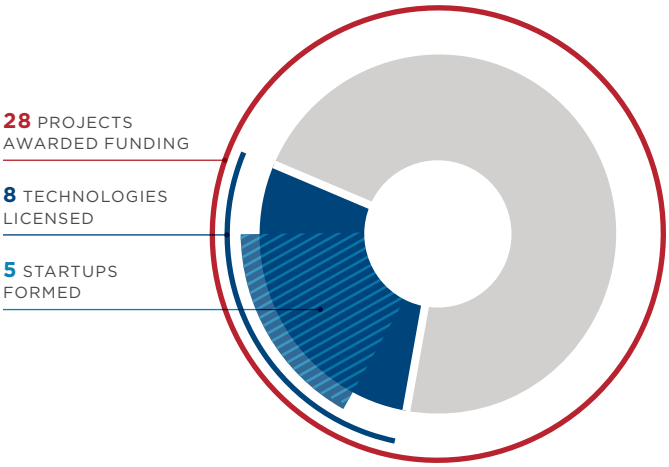
With QED entering its eighth year in 2016, the Science Center engaged the Economy League of Greater Philadelphia to carry out an independent evaluation of the program's performance and impact to date. The assessment revealed that as both a source of critical early-stage commercialization funding and a collaborative platform for scientists, entrepreneurs, investors, industry leaders, and institutional administrators, QED plays a crucial role within Greater Philadelphia's innovation ecosystem.

QED PARTICIPANTS REPORT OVERALL SATISFACTION WITH THE PROGRAM.

The scientists, entrepreneurs and industry professionals, and institutional administrators who have engaged with QED give the program high marks overall.

- *90% of QED researchers surveyed report that participating in QED was a valuable experience.*
- *90% of industry professionals and institutional administrators surveyed believe that QED helps strengthen Greater Philadelphia's innovation ecosystem.*

THE QED PROGRAM HAS SCREENED 475 PROPOSALS FROM PARTICIPATING INSTITUTIONS.



KEY OUTCOMES

QED HELPS BREAKTHROUGH IDEAS ADVANCE OUT OF THE LAB.

- *Since 2009, QED has screened 475 technologies.*
- *94 projects have been accepted into the program, pairing scientists with industry professionals.*
- *QED has awarded a total of $4.85 million to 28 projects primarily in the Therapeutic/Biologic, Device/Diagnostic, and Digital Health sectors.*
- *Projects that have received QED funding have raised a combined $19.2 million in follow-on funding.*
- *29% of projects that have received QED funding have been licensed.*
- *18% of projects that have received QED funding have gone on to form startup companies.*

QED CULTIVATES ENTREPRENEURIAL TEAMS.

- *Researchers and Business Advisors view the connections and long-term relationships that they build through QED as key outcomes of engaging in the program.*
- *More than 90% of researchers surveyed found their relationships with QED Business Advisors to be valuable.*
- *Two-thirds of QED Business Advisors report good or excellent interactions with the researchers on their teams.*

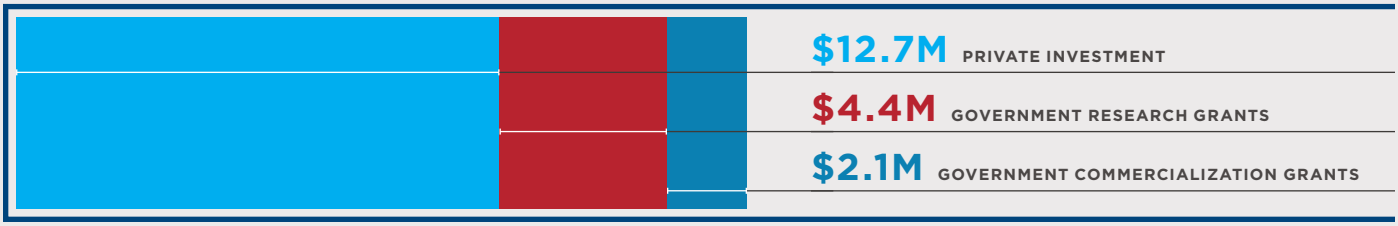
QED HELPS AREA INSTITUTIONS DEVELOP A CULTURE OF COMMERCIALIZATION AND ENTREPRENEURSHIP.

- *Three out of four researchers surveyed say that participating in QED has helped them better understand the commercialization process and has changed how they think about the impact of their research.*
- *Three out of four institutional administrators surveyed believe that QED has helped promote commercialization at their institutions.*

QED CONNECTS ACADEMIA WITH INDUSTRY.

- *QED has connected 94 institutional research teams with 82 volunteer Business Advisors.*
- *More than 100 life sciences industry leaders have served on the QED Selection Team, evaluating and providing feedback on research projects.*
- *98% of Business Advisors and Selection Team members surveyed say that QED has allowed them to learn about new research at area institutions.*

QED PROJECTS HAVE RAISED A COMBINED $19.2 MILLION IN FOLLOW-ON FUNDING.



Findings reflect seven years of program activity and are current as of October 2016.

EARLY-STAGE FUNDING & TECHNOLOGY TRANSFER

The pace of life sciences and healthcare advancement today can seem incredibly fast, but the reality is that innovation does not happen overnight, nor in a single leap. Successfully moving a discovery out of a lab and on the path to market involves a vast number of steps, perspectives, and resources—and the path is not a straight one. Navigating the long and capital-intensive research and development process, when commercial success is far from certain, is a daunting proposition. Public funding often supports new discoveries and groundbreaking science, while commercial investment is often directed at developing "market-readiness" for technologies for which much of the technical risk has already been retired. This leaves a gap that must be bridged to transition technologies from "discovery" to "development." The challenge of finding funding to make that leap is particularly pronounced in the life sciences where projects typically face long development timelines, several regulatory hurdles, and high risk of failure.

Across the U.S., a shortage of early-stage commercialization funding for life sciences research inhibits commercialization and limits the amount of innovation that reaches the market. This certainly holds true in Greater Philadelphia, where the level of innovation activity powered by the region's globally-renowned research universities, research hospitals, and life sciences institutions; its robust pharmaceutical and life sciences industry cluster; and its growing startup culture far outstrips the amount of funding available to advance early-stage technologies.

To help alleviate this funding shortage, universities, healthcare institutions, government agencies, and intermediary organizations around the country have created proof-of-concept programs to retire the business risks associated with life sciences technologies earlier in the development process, thereby more quickly and efficiently identifying those that are positioned to attract next-stage investment.

Beyond the clear potential to drive healthcare innovation and improve patient outcomes, facilitating life sciences commercialization activity has been shown to be a promising strategy for stimulating economic development. By providing critical support necessary for promising technologies to continue along the commercialization pipeline, proof-of-concept programs can support job creation, startup formation, and economic activity, as and when technologies make it to market.

Below: Dr. Joyce Tombrin-Tink, Professor, The Pennsylvania State University, 2012 QED Awardee.

"PROGRAMS LIKE QED HAVE BEEN CRITICALLY IMPORTANT TO THE UNIVERSITY AS WE HAVE BEEN STRIVING TO CHANGE ACADEMIC CULTURE AND PERCEPTIONS RELATING TO COMMERCIALIZATION. WE'VE BEEN ABLE TO UTILIZE QED AS A KEY MEANS TO ENGAGE FACULTY IN THE PROCESS. TODAY, TEMPLE IS ONE OF THE REGION'S MOST ACTIVE ENGINES FOR COMMERCIALIZATION OF PUBLICLY-FUNDED TECHNOLOGIES."

—*MICHELE MASUCCI, Ph.D., VICE PRESIDENT FOR RESEARCH ADMINISTRATION,* ***TEMPLE UNIVERSITY***

THE QED PROOF-OF-CONCEPT PROGRAM

In Greater Philadelphia, the University City Science Center's QED Proof-of-Concept Program plays a key role in supporting the commercialization of promising research at area institutions. QED provides early-stage funding and business support for novel technologies with market potential, enabling them to succeed or fail quickly. The program's primary goal is to reduce commercialization risk in early-stage projects, thus increasing their attractiveness to established companies and private investors.

QED STANDS FOR QUOD ERAT DEMONSTRANDUM, OR "PROVEN AS DEMONSTRATED."

Supporting Innovation at All Stages

IN ADDITION TO QED, the Science Center provides a host of services that support innovation and guide projects through the commercialization pipeline. Since 1963, 442 firms have received business incubation services from the Science Center and 155 are still operating in the Greater Philadelphia region. These Science Center-incubated firms support one out of every 100 jobs in the region and drive nearly $13 billion in annual economic activity.

QUORUM, the entrepreneurs clubhouse, convenes members of the region's innovation ecosystem via programs, events, informal meetups and a coworking lounge.

PHASE 1 VENTURES provides business expertise, tools, and funding to launch and grow startups focused on long-horizon technologies.

THE PORT BUSINESS INCUBATOR offers startups turnkey office and lab facilities and professional services.

THE DIGITAL HEALTH ACCELERATOR helps companies move from prototype development to customer acquisition.

Researchers who participate in QED often return to the Science Center to take advantage of this suite of services as they continue their path to commercialization.

QED grew out of regional conversations focused on how best to connect universities and other research institutions with industry expertise to drive economic development in the Philadelphia area. The Greater Philadelphia Chamber of Commerce's CEO Council for Growth, identifying the potential of technology transfer as a tool for economic development, issued a report in 2007 that laid out three key areas of need for Greater Philadelphia: fostering a culture of entrepreneurship, accelerating connections between researchers and entrepreneurs, and building the talent and capital resources to grow new companies. The report included as a priority action item the creation of a fund to support proof-of-concept research.

The Science Center responded to this call and in 2009 partnered with 10 area institutions to launch QED, one of the nation's first multi-institutional proof-of-concept programs focusing on life sciences. Since its creation, QED has received funding support from the U.S. Economic Development Administration, the Commonwealth of Pennsylvania's Department of Community and Economic Development, the Commonwealth of Pennsylvania's Department of Health, the Philadelphia Industrial Development Corporation, the William Penn Foundation, and Wexford Science + Technology, in addition to ongoing support from the Science Center and QED participating institutions.

Today, QED works with 21 academic and research institutions in three states, embracing a regional approach to proof-of-concept funding that identifies and supports promising projects across large and small universities, research hospitals, and life sciences research institutes. Specifically, QED supports life sciences and digital health technologies that have already generated bench data, and assists with the development of pre-clinical or early clinical data to advance these projects along the commercialization pipeline. Among the projects funded through the program thus far are technologies that have the potential to transform disease diagnosis and treatment, enhance research discovery capabilities, and train healthcare workers to improve patient interactions and outcomes.

QED PARTICIPATING INSTITUTIONS

In 2015, QED's 21 participating institutions were collectively responsible for approximately $1 billion in R&D activity supported by the National Institutes of Health.

HOW QED WORKS

THE QED PROCESS

PROJECT SELECTION

Life sciences researchers at QED's 21 participating institutions submit brief project "white paper" proposals. For a proposal to be eligible for QED, its intellectual property must be managed by one of the program's participating institutions. A Selection Team made up of industry and investment professionals reviews the proposals and recommends 10–15 finalists to move to the next stage.

BUSINESS ADVICE

Finalists are matched with Business Advisors who provide mentoring and commercial perspectives in developing full-fledged Proof-of-Concept Plans over three to four months. These finalist teams are connected with additional expertise in intellectual property law, regulatory requirements, and other key areas as needed through Specialist Clinics.

PROOF-OF-CONCEPT FUNDING

The QED Selection Team, with input from technical reviewers, evaluates the finalists' Proof-of-Concept Plans and recommends projects to receive awards of up to $200,000 each to implement the Proof-of-Concept Plans over a 12-month period. QED provides half of each award, with matching funds coming from the researcher's home institution. Following the award, teams develop milestone plans and continue to receive support from Business Advisors and Science Center staff for one year.

MARKET EXPOSURE

Science Center personnel and additional industry and investment representatives review the progress of projects during proof-of-concept implementation, and work with the awardees' technology transfer offices to facilitate the successful transition of technologies into the private sector.

WHO IS INVOLVED

ACADEMIC RESEARCHERS

Principal investigators and supporting postdocs at participating institutions lead projects through the QED process.

INSTITUTIONAL TECH TRANSFER LEADERS

Administrators at 21 participating institutions direct candidates to QED, support researchers through the program, and conduct post-QED transactions and updates.

ENTREPRENEURS, INVESTORS, & INDUSTRY EXPERTS

Industry professionals lend their expertise as members of the QED Selection Team and volunteer as Business Advisors for program finalists and awardees.

SCIENCE CENTER STAFF

Dedicated Science Center staff manage the program, support finalists and awardees, and act as liaisons between researchers, industry professionals, and institutional administrators.

BENCHMARKING THE QED PROGRAM

Institutions around the U.S. have created proof-of-concept funds to support commercialization of promising early-stage technologies. While these programs share many attributes, many differ as to whom they serve, the fields on which they focus, and where in the commercialization "pipeline" they fit. The table below illustrates how QED compares to three gold-standard proof-of-concept programs around the country.

QED is a newer program than those benchmarked below, and many of the technologies it has funded to date have long horizons. Consequently, most QED projects have yet to reach a stage of development where they can attract significant follow-on venture capital investment. As QED-funded projects progress further along the development pipeline, it can be expected that follow-on funding—and program return on investment, in turn—will grow.

NAME & LOCATION	QED PHILADELPHIA, PA	COULTER-DREXEL TRANSLATIONAL RESEARCH PARTNERSHIP PHILADELPHIA, PA	MIT DESHPANDE CENTER FOR TECHNOLOGICAL INNOVATION CAMBRIDGE, MA	VON LIEBIG ENTREPRENEURISM CENTER AT UCSD SAN DIEGO, CA
PROGRAM FOCUS	QED provides business development support for academic researchers developing early-stage life sciences and healthcare IT technologies at 21 participating institutions. The key goal is to retire the business risk and increase attractiveness to follow-on investment.	The annual grant to Drexel from the Coulter-Drexel Translational Research Partnership program sponsors collaborative translational research projects led by teams of Drexel engineers and scientists in partnership with clinical faculty. The mission is to address unmet healthcare needs and improve patient care.	The Deshpande Center aims to move technology out of MIT labs and into the marketplace. The Center provides grants and support to reduce the technical and market risk of projects to the point that a company can spin out. The program selects MIT faculty and student projects with proven science that are likely to be in the market within four years.	Housed in the UC San Diego Jacobs School of Engineering, Von Liebig provides proof-of-concept funding to move UCSD faculty and student research out of the lab, and offers entrepreneurship training and mentoring for students. The Center also serves as an NSF I-Corps site.
YEAR ESTABLISHED	2009	2006	2002	2001
TOTAL FUNDING AWARDED	$4.85M	$6.5M	$16.5M	$6M
PROJECTS FUNDED	28	50	125	142
STARTUPS FORMED	5	5	32	67
FOLLOW-ON FUNDING	$19.2M	NOT AVAILABLE	$600M	$150M
RATIO OF FOLLOW-ON FUNDING TO TOTAL FUNDING AWARDED	4:1	NOT AVAILABLE	36:1	25:1

Figures current as of October 2016.

UNDERSTANDING QED'S IMPACTS

As both a source of critical proof-of-concept funding for early-stage commercialization research and a collaborative platform for scientists, entrepreneurs, investors, industry leaders, and institutional administrators, QED plays an important role within Greater Philadelphia's innovation ecosystem. With the program entering its eighth year in 2016, the Science Center is committed to ensuring that QED is meeting its commercialization goals, serving the needs of researchers and participating institutions, and supporting the growth and evolution of the region's innovation community.

Above: Dr. Sunday Shoyele, Associate Professor, Thomas Jefferson University, 2014 QED Awardee.

"THE QED PROCESS WAS A BRILLIANT EXPERIENCE. IT BROUGHT US TO THE POINT OF CREATING A STARTUP COMPANY, WHICH I HAD NOT GONE INTO THE PROGRAM 100% CONVINCED THAT WE WOULD BE ABLE TO DO."

—*MARINA D'ANGELO, Ph.D., PROFESSOR OF ANATOMY,* ***PHILADELPHIA COLLEGE OF OSTEOPATHIC MEDICINE,*** *QED FINALIST*

To aid in this effort, the Science Center engaged the Economy League of Greater Philadelphia to carry out an independent evaluation of QED's performance and impact to date. The Economy League developed a replicable program assessment framework based on close examination of leading proof-of-concept programs around the U.S. and input from a project Steering Committee made up of Philadelphia-area researchers, entrepreneurs, institutional administrators, and economic development professionals.

More than 100 stakeholders provided feedback on QED via survey and 29 individuals shared their input on the program via focus group or individual interview.[1]

The input gathered by the Economy League through this assessment yields a broad understanding of QED's key impacts on Greater Philadelphia's innovation ecosystem. These impacts—on projects, scientists, industry professionals, and institutions—are described below.[2]

QED PARTICIPANTS REPORT OVERALL SATISFACTION WITH THE PROGRAM.

The scientists, entrepreneurs and industry professionals, and institutional administrators who have engaged with QED give the program high marks overall.

90% OF QED RESEARCHERS SURVEYED REPORT THAT **PARTICIPATING IN QED WAS A VALUABLE EXPERIENCE.**

THREE OUT OF EVERY FOUR PARTICIPATING RESEARCHERS SAY THAT **QED HAS HAD AN IMPACT ON THEIR UNDERSTANDING OF GREATER PHILADELPHIA'S INNOVATION ECOSYSTEM.**

90% OF INDUSTRY PROFESSIONALS AND INSTITUTIONAL ADMINISTRATORS SURVEYED BELIEVE THAT **QED HELPS STRENGTHEN GREATER PHILADELPHIA'S INNOVATION ECOSYSTEM.**

100% OF INSTITUTIONAL ADMINISTRATORS SURVEYED SAY THAT THEY WILL **CONTINUE TO DIRECT PROJECTS TO QED.**

[1] *See page 22 for more information on study methodology.*
[2] *Findings reflect seven years of program activity and are current as of October 2016.*

QED HELPS BREAKTHROUGH IDEAS ADVANCE OUT OF THE LAB.

By providing up to $200,000* in technical proof-of-concept funding, QED plays an important role in helping scientists bring their research out of the lab, allowing them to attract investors, license their technology, or form a startup. The program supports early-stage commercialization research with high market potential that otherwise may not have been funded. Not only can these innovations transform lives, but they also have the potential to drive economic growth in the region.

SINCE 2009, QED HAS SCREENED **475 SUBMISSIONS** FROM **379 RESEARCHERS** AT 20 PARTICIPATING INSTITUTIONS.

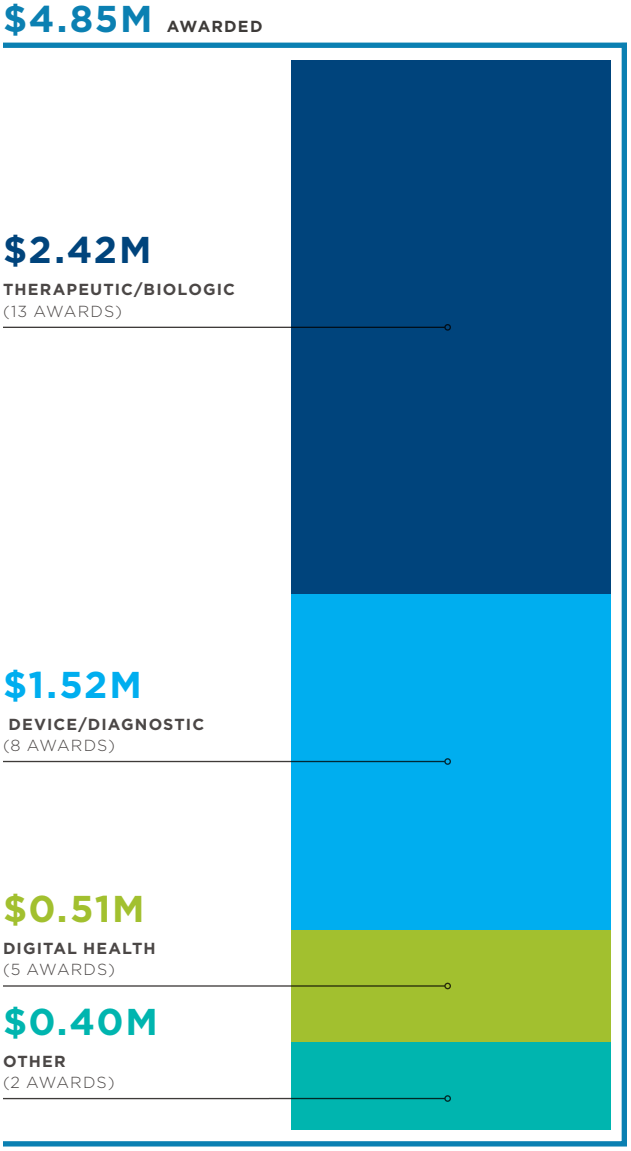
THROUGH QED, SCIENTISTS AND INDUSTRY PROFESSIONALS HAVE WORKED TOGETHER TO DEVELOP **PROOF-OF-CONCEPT PLANS FOR 94 PROJECTS.**

PROJECTS THAT HAVE RECEIVED QED FUNDING HAVE **RAISED A COMBINED $19.2 MILLION IN FOLLOW-ON FUNDING,** INCLUDING $12.7 MILLION IN PRIVATE INVESTMENT, $2.1 MILLION IN GOVERNMENT COMMERCIALIZATION GRANTS AND $4.4 MILLION IN GOVERNMENT RESEARCH GRANTS.

29% OF PROJECTS THAT HAVE RECEIVED QED FUNDING **HAVE BEEN LICENSED.**

18% OF PROJECTS THAT HAVE RECEIVED QED FUNDING **HAVE GONE ON TO FORM STARTUP COMPANIES.**

QED HAS AWARDED A TOTAL OF $4.85 MILLION TO 28 PROJECTS PRIMARILY IN THE THERAPEUTIC/ BIOLOGIC, DEVICE/DIAGNOSTIC AND DIGITAL HEALTH SECTORS.



*QED award funding is provided in equal parts by the Science Center and the recipient's home institution.

Statistics listed are current through October 2016.

QED CULTIVATES ENTREPRENEURIAL TEAMS.

Collaboration is key to successfully commercializing a novel technology. Researchers, institutional administrators, industry professionals, and investors must work together to bring an idea from the lab to the marketplace. The Science Center and QED provide a supportive setting to bring together these different players to move projects forward. In several cases, Business Advisors have continued working with researchers after QED, going on to form companies or pursue other ventures together.

RESEARCHERS AND BUSINESS ADVISORS VIEW THE **CONNECTIONS AND LONG-TERM RELATIONSHIPS** THAT THEY BUILD THROUGH QED AS KEY OUTCOMES OF ENGAGING IN THE PROGRAM.

MORE THAN 90% OF RESEARCHERS SURVEYED FOUND THEIR RELATIONSHIPS WITH QED BUSINESS ADVISORS TO BE VALUABLE.

TWO-THIRDS OF QED BUSINESS ADVISORS REPORT **GOOD OR EXCELLENT INTERACTIONS** WITH THE RESEARCHERS ON THEIR TEAMS.

MORE THAN TWO-THIRDS OF RESEARCHERS SURVEYED REPORT THAT THE **FEEDBACK** THEY RECEIVED THROUGHOUT THE PROOF-OF-CONCEPT DEVELOPMENT PROCESS AND FROM THE QED SELECTION TEAM **WAS VALUABLE TO ADVANCING CURRENT AND FUTURE PROJECTS.**

"I LOVE WORKING WITH THESE ASPIRING ENTREPRENEURS, AND IT HAS LED TO A PERMANENT GIG FOR ME WITH A STARTUP."

—DEB TRAVERS, QED BUSINESS ADVISOR

QED HELPS AREA INSTITUTIONS DEVELOP A CULTURE OF COMMERCIALIZATION AND ENTREPRENEURSHIP.

QED's network of 21 participating institutions includes universities, research hospitals, and life sciences research institutions in Pennsylvania, New Jersey, and Delaware with varying levels of commercialization-related resources. The program serves as an important resource for administrators at these institutions working either to cultivate faculty interest in translational research or accommodate growing demand for commercialization support. To date, QED has screened 475 project submissions from 379 researchers at 20 participating institutions. For many researchers, QED is their first exposure to commercialization and the world of business, and their experience with the program sparks a deep and enduring interest in technology commercialization.

THREE OUT OF FOUR RESEARCHERS SURVEYED SAY THAT PARTICIPATING IN QED HAS HELPED THEM BETTER **UNDERSTAND THE COMMERCIALIZATION PROCESS** AND **CHANGED HOW THEY THINK** ABOUT THE IMPACT OF THEIR RESEARCH.

INSTITUTIONAL ADMINISTRATORS CITE QED'S ABILITY TO INCREASE RESEARCHERS' UNDERSTANDING OF COMMERCIALIZATION AND **CONNECT THEM WITH ENTREPRENEURS AND INDUSTRY PROFESSIONALS** AS ONE OF THE PROGRAM'S PRIMARY BENEFITS.

"QED IS AN EFFECTIVE COMPLEMENT TO JEFFERSON'S OWN INNOVATION INITIATIVES. THE FUNDING IS A BIG BOOST FOR RESEARCHERS AND THE QED PROGRAM CAN REALLY MOVE THE NEEDLE."

—ROBIN SHELDON, JD, MPIA, VICE PRESIDENT OF INNOVATION MANAGEMENT,
THOMAS JEFFERSON UNIVERSITY

THREE OUT OF FOUR INSTITUTIONAL ADMINISTRATORS SURVEYED BELIEVE THAT QED HAS HELPED **ADVANCE THE CULTURE OF COMMERCIALIZATION** AT THEIR INSTITUTION.

QED CONNECTS ACADEMIA WITH INDUSTRY.

By connecting participating scientists to a network of nearly 200 volunteer Business Advisors and a Selection Team that draws from more than 100 investors and industry experts, QED serves as a bridge between industry and academia. These connections are key to leveraging university research to promote industry growth in Greater Philadelphia and beyond.

QED HAS CONNECTED **94 ACADEMIC RESEARCH TEAMS** WITH **82 VOLUNTEER BUSINESS ADVISORS**, 35 OF WHOM HAVE SUPPORTED MULTIPLE PROJECTS OVER SEVERAL YEARS.

MORE THAN 100 LIFE SCIENCES INDUSTRY LEADERS HAVE SERVED ON THE QED SELECTION TEAM, EVALUATING AND PROVIDING FEEDBACK ON RESEARCH PROJECTS.

98% OF QED BUSINESS ADVISORS AND SELECTION TEAM MEMBERS SURVEYED CITE **LEARNING ABOUT NEW RESEARCH AT AREA INSTITUTIONS** AS A TOP OUTCOME OF PARTICIPATING IN THE PROGRAM.

85% OF INSTITUTIONAL ADMINISTRATORS SURVEYED REPORT THAT QED HAS **HELPED CONNECT RESEARCHERS** AT THEIR INSTITUTIONS **TO ENTREPRENEURS.**

"QED MADE ME VERY AWARE THAT THERE IS A DIFFERENCE BETWEEN PRODUCING SOMETHING IN THE LAB AND MANUFACTURING SOMETHING FOR COMMERCIALIZATION."

—JOSEPH FREEMAN, Ph.D., ASSOCIATE PROFESSOR,
***RUTGERS, THE STATE UNIVERSITY OF NEW JERSEY**, QED FINALIST*

QED PROJECT SPOTLIGHT:

The iBreastExam

Expanding access to early detection for breast cancer.

A traditional mammogram requires bulky, expensive equipment and trained technicians and radiologists to administer and interpret x-ray results. Imagine instead a low-cost, portable, hand-held scanner that can detect breast cancer in its earliest stages, anywhere. The realization of such a technology is the fruit of more than a decade of research by Drs. Wan and Wei-Heng Shih, Drexel University engineering professors. They developed new sensor technology that works like super-sensitive fingers to detect hardened or dense tissue that may be cancerous. Because of their technology's high potential to change the way we screen for breast cancer, in 2009 the Shihs were awarded one of the three inaugural QED awards to further develop their technology.

Participating in QED was an eye-opening introduction to the business world for the Shihs. As Dr. Wan Shih puts it, "the business support and connections to the broader business network we received from QED were instrumental to commercializing our invention." They also credit QED and the business advice they received with helping them to move beyond a sole focus on the technical aspects of their project to harnessing the commercialization potential of their technology. At the end of the one-year award period, the Shihs had developed a clinical prototype and successfully conducted clinical trials on 40 patients.

Their technology's journey to market demonstrates the strength and variety of support and resources within Pennsylvania's innovation ecosystem. Initial bench development was first developed with support from a Coulter-Drexel Translational Research Award. The initial clinical testing supported by QED attracted the attention of Drexel alumnus and entrepreneur Mihir Shah. Inspired by his own family's experiences with cancer, Shah had founded UE LifeSciences, a startup focused on improving diagnostics for breast cancer worldwide. He licensed the Shihs' sensor technology in 2010.

Two years later, Shah won an $878,000 grant from the Pennsylvania Department of Health's Commonwealth Universal Research Enhancement (CURE) program. This award funded further research and product development for a commercially viable prototype over two and a half years. Shah then returned to the Science Center as

IMPROVING HEALTHCARE & PATIENT OUTCOMES

SINCE 2009, QED has supported 28 projects aimed at developing new treatments and diagnostics, and improving the delivery and effectiveness of patient care. Examples include:

- **Better options for patients with COPD.** Dr. Mayuresh Kothare of **Lehigh University** developed a miniaturized mechanism that delivers oxygen-rich gas from ambient air, allowing greater energy efficiency and lower costs. This technology can be used to help patients with chronic obstructive pulmonary disease (COPD).

- **Therapy for diabetic retinopathy.** Dr. Joyce Tombran-Tink of **The Pennsylvania State University** developed an eye drop therapy for diabetic retinopathy, a condition which can cause vision problems and even blindness.

"THE BUSINESS SUPPORT AND CONNECTIONS TO THE BROADER BUSINESS NETWORK WE RECEIVED FROM QED WERE INSTRUMENTAL TO COMMERCIALIZING OUR INVENTION."

—WAN SHIH, Ph.D., ASSOCIATE PROFESSOR, SCHOOL OF BIOMEDICAL ENGINEERING, SCIENCE AND HEALTH SYSTEMS, ***DREXEL UNIVERSITY***

a participant in its Digital Health Accelerator (DHA). DHA provided targeted mentoring and advice, and Shah used the funding from DHA to apply for FDA regulatory approval, which was granted in April 2015.

Today, UE LifeSciences is commercializing the technology under the name iBreastExam (iBE) in India, where there is a dramatic need for earlier breast cancer detection. The breast cancer death rate incidence in the country is among the highest in the world, with a mere 50% chance of survival upon diagnosis. Because iBE is both extraordinarily portable and requires less training to operate than traditional diagnostic devices, its potential for market penetration is promising. Shah aims to get 1,000 units into the Indian market and screen one million women within iBE's first year, all at the low cost of $1 per scan. UE LifeSciences also has its sights set on additional markets. The firm, which today employs 30 people in three offices, has raised an additional $4.2 million in venture capital funding, and Shah hopes to expand to other developing countries in 2017.

While iBE's reach has become global, Shah is committed to keeping UE LifeSciences' headquarters in Philadelphia. As he says, "we have received invaluable support from the Science Center, Drexel University, and the Commonwealth, and Philadelphia is a robust center for healthcare innovation." Shah plans to keep the firm's research and development activity in Philadelphia due to both the region's strong talent pool and the high degree of connectivity that facilitates familiarity with the key players in life sciences innovation and investment.

Drs. Wan and Wei-Heng Shih have also continued on their own commercialization journey. After being introduced to the Science Center through QED, the Shihs have returned to what they describe as the "nurturing environment" that the Science Center provides. They founded a startup around a separate technology and are working to build the company out of the Science Center's Port business incubator. They continue to view QED as an important commercialization funding source for future inventions. ■

Patient-derived stem cells. **Rutgers, The State University of New Jersey** scientist Dr. KiBum Lee is developing a platform for programming human patient-derived stem cells for use in therapies for incurable and debilitating diseases.

Training healthcare professionals. Amy Cowperthwait and Amy Bucha of the **University of Delaware** are developing a new tool for teaching healthcare workers techniques for airway management in emergency situations, improving patient safety and providing feedback from the patient's perspective.

LOOKING TO THE FUTURE

With a replicable program assessment framework in hand, the Science Center is committed to continued tracking of QED activity and outcomes to ensure that the program is meeting its commercialization goals and serving the needs of Greater Philadelphia's evolving innovation community.

In addition to providing a thorough understanding of the impacts that QED has had on the region's innovation ecosystem, the process of evaluating QED has suggested possible future areas of focus. On the basis of findings from benchmarking interviews, the QED Steering Committee feedback, and participant survey and focus groups, the Science Center has identified the following four possible focus areas going forward.

SCALING QED WHILE MAINTAINING COMPETITION AMONG APPLICANTS TO INCREASE PROGRAM IMPACT.

Participants and institutional administrators view QED as a strong program, and awardees generally report that the amount of each individual award is adequate for executing Proof-of-Concept Plans. They also note that the program's impact is limited by its size and that the region's technology potential is greater than the number of awards made by the program. QED can build on its track record of advancing high-quality research by increasing the number of awards made annually. However, any effort to scale QED should take into consideration the value of competition in surfacing high-quality opportunities across a large number of institutions.

A MENU OF COMMERCIALIZATION SUPPORT OPTIONS TAILORED TO THE VARYING NEEDS OF QED PARTICIPATING INSTITUTIONS.

While QED's multi-institutional nature positions it for broad impact, the varying levels of available commercialization resources at QED participating institutions make a one-size-fits-all approach to program management and communications difficult. For institutions with dedicated technology transfer offices and deep institutional knowledge in commercialization, QED is a valuable tool, but not the only one. For institutions with little in the way of dedicated commercialization resources or experience, QED can represent the only avenue for translating faculty research into the market. This variation in need and general commercialization fluency—not to mention the sheer size of the 21-partner QED network—presents a management challenge. Considering a more customized approach may enhance program focus, processes, and timelines.

EXPANDED NETWORKING OPPORTUNITIES TO HELP QED PARTICIPANTS FURTHER DEVELOP AND MAINTAIN PRODUCTIVE RELATIONSHIPS.

Participants consistently report that the relationships that they build through the program are among its primary benefits. Many say they would value additional opportunities to network and build relationships during and after the program. Specifically, scientists and institutional administrators indicated that the Science Center could leverage QED's multi-institutional structure to allow them to build connections with peers at other institutions. Finalists, awardees, and Business Advisors also expressed an interest in programming for QED alumni that provides opportunities for them to connect after their participation in the program has concluded.

MORE FORMAL EXIT PARTNERSHIPS TO BENEFIT QED-FUNDED PROJECTS.

Several awardees and Business Advisors noted that as the QED award term comes to an end, stronger connections to investors and additional funding partnerships could help projects continue along the commercialization path. Possibilities include connectivity to follow-on programs in the region, such as Phase 1 Ventures, or the creation of formal relationships with industry or investor organizations that could provide follow-on investment.

STUDY METHODOLOGY

The findings presented in this report are based on an independent assessment of the QED program conducted in 2016 by the Economy League of Greater Philadelphia on behalf of the University City Science Center. Drawing upon background research on proof-of-concept programs across the U.S.; interviews with leadership at the University of California San Diego's Von Liebig Entrepreneurism Center, the Massachusetts Institute of Technology's Deshpande Center for Technological Innovation, the Harrington Discovery Institute's Cleveland-based Scholar–Innovator Program, and the Coulter Foundation's nationwide Translational Partnership Award in Biomedical Engineering; and input from regional stakeholders and Science Center staff, the Economy League developed a customized, replicable assessment framework for QED targeting both short-term program outputs and longer-term program outcomes.

The Economy League used this assessment framework to undertake a comprehensive evaluation of QED's performance and impacts. This evaluation consisted of online stakeholder surveys, one-on-one interviews, focus groups, and analysis of existing Science Center data on QED. The surveys targeted six distinct QED stakeholder groups (program awardees, finalists not awarded funding, applicants not selected as finalists, Business Advisors, members of the QED Selection Team, and administrators at QED participating institutions) and included questions on the effectiveness and value of various components of the QED program, the impact of the program on stakeholders' professional development, reasons for participating, outcomes of program participation, and QED's role in Greater Philadelphia's innovation ecosystem. Surveys were sent to a total of 590 stakeholders; 111 provided feedback. The Economy League also convened two focus groups—one for QED awardees, finalists, and Business Advisors; and one for members of the QED Selection Team and administrators at QED participating institutions. At these focus groups, a total of 19 stakeholders provided detailed feedback on the QED program and processes, its impacts, and its role in the regional innovation ecosystem. The Economy League also conducted direct interviews with 10 program participants and representatives of QED participating institutions.

The Economy League and the Science Center also convened a project Steering Committee including researchers, entrepreneurs and industry professionals. The Steering Committee met three times over the course of the nine-month study and was instrumental in guiding the formulation of the QED assessment framework and the interpretation of assessment findings. Input gathered via survey, focus group, interviews, and from the Steering Committee was analyzed in combination with existing Science Center data on past submissions and outcomes for QED-awarded projects to develop the findings presented in this report.

ACKNOWLEDGMENTS

The Science Center thanks the following for their contributions to this study:

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