THE VALUE OF COLLABORATION: PARTNERSHIPS ARE A PATH TO SUCCESS

By David Holthaus

Michael Jordan may be the greatest basketball player ever, but he knew he couldn't win on his own.

"Talent wins games, but teamwork and intelligence win championships," Jordan is quoted as saying. That was true of his Chicago Bulls. It wasn't until a visionary coach built a team around Jordan that the once-forlorn Bulls won six championship titles.

This advice is true in business too. Ground-breaking ideas need the fertile soil provided by partners in business, government, and academia so the concepts can germinate and grow.

A network of partnerships helped propel a small business called SpheroFill LLC to research and develop innovative medical applications for a cutting-edge technology. While serving as a senior scientist at Savannah River National Laboratory in South Carolina, George Wicks invented porous wall hollow glass microspheres, originally for strategic purposes.

Wicks was convinced there were other uses for the technology, and the laboratory put out a request for proposals for new uses. As Paul Weinberger tells it, he and a colleague, William Hill, both submitted proposals, both of them for regenerative medicine. Weinberger's was for regrowing tracheas, while Hill's was for regrowing bone.

The spheres, one-third the size of a human hair, about 20–40 microns, contain channels or pores through which liquids, gases, or solids could pass into the hollow void of the sphere. "That gave us the idea to use it as a carrier for molecules," Weinberger says.

Both of their ideas received funding, and as the two of them began collaborating with Wicks, a partnership gelled.

"By the second or third meeting, we came to the realization that we really got along well together, and regardless of what happened to our individual projects, we'd be friends, and we started to work on this together long-term," Weinberger says.

A three-dimensional sound field created by Materials Development Inc. enables levitation of 25 styrofoam spheres. The process allows for measurements using neutron methods to study how liquids change into glass and to investigate extreme temperature processes. *Credit: Materials Development Inc.*

The three brainstormed further possibilities for the technology, including the possibility of developing it as a soft-tissue surgical filler. After reviewing the literature, they determined that that such an application had not yet been developed. "We realized if we didn't do it, nobody would," Weinberger says.

In 2015, they formed SpheroFill and were awarded patents from several countries, including the United States, Japan, and the European Union. A partnership with the Applied Research Center (ARC) helped build the technology. ARC is a not-for-profit economic development agency located in Aiken County, S.C., at the county-owned Savannah

River Research Campus. SpheroFill set up shop there with seed funding, lab space, access to an electron microscope and analysis equipment, and expert consultants.

Other than the seed grant, the partners bootstrapped the new company using funds from their retirement savings, Weinberger says. Earlier this year, their work received a big boost when the National Science Foundation (NSF) awarded the team a $256,000 grant to continue their research.

"The NSF's stamp of approval is huge," Weinberger says. "They have a huge infrastructure for picking up companies and carrying them across the finish line and showing them what it takes to bridge the gap commercially."

With an annual budget of $8.5 billion, the NSF is the funding source for about 25% of all federally supported basic research conducted by U.S. colleges and universities.

The Advanced Photon Source at Argonne National Laboratory in Lemont, Ill. *Credit: Argonne National Laboratory*

The grant process was difficult, Weinberger says. With an application that ran to more than 200 pages, the SpheroFill team had help from the South Carolina Research Authority, a public, not-for-profit corporation, as well as from a former university dean of research and development turned consultant.

"Those were things we had no experience with," Weinberger says. "We relied on our newfound partners and collaborators. It was a humbling but very strong learning experience."

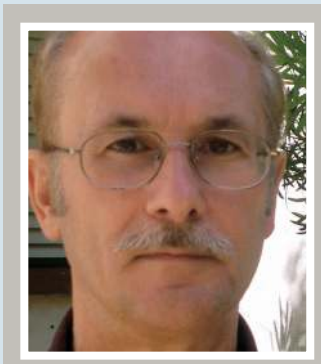
The grant came from the NSF's Small Business Technology Transfer Program, designed to help small businesses transform ideas into marketable products. After completing the 12-month Phase I award, the company will be eligible for a second round of investment from NSF.

The government funding is critical to a small company, such as SpheroFill, engaged in long-term research into leading-edge technology, Weinberger says.

"We could have languished and floundered and not gone anywhere," he says. "It takes so much to de-risk new biomedical technologies. It's so much expense, and no investor will touch a company that was at the stage we were at a year ago."

Small businesses such as SpheroFill work on problems that are big and complex. That's why they need help from government and other partners, says Rick Weber. Weber in 2006 founded Materials Development Inc., or MDI. MDI has developed an instrument to process and study materials in extreme conditions.

Weber had worked with a company developing advanced instruments for NASA flight experiments and realized that the noncontact processing tools he was helping to develop could be used for processing advanced glasses. Studying materials in extreme temperatures is confounded by the container. A perfectly inert container does not exist in nature, so experiments can be contaminated.



Rick Weber

Weber's solution was to eliminate the container and use acoustic and aerodynamic forces to levitate materials so they float at temperatures as high as 3,500°C. The materials can then be probed with neutron or X-ray beams to investigate their structure and reactions to such extreme conditions. The process is useful for creating high-performance optical and laser glasses, defect-free crystals for the semiconductor industry, aerospace alloys, and, at lower temperatures, development of amorphous pharmaceuticals.

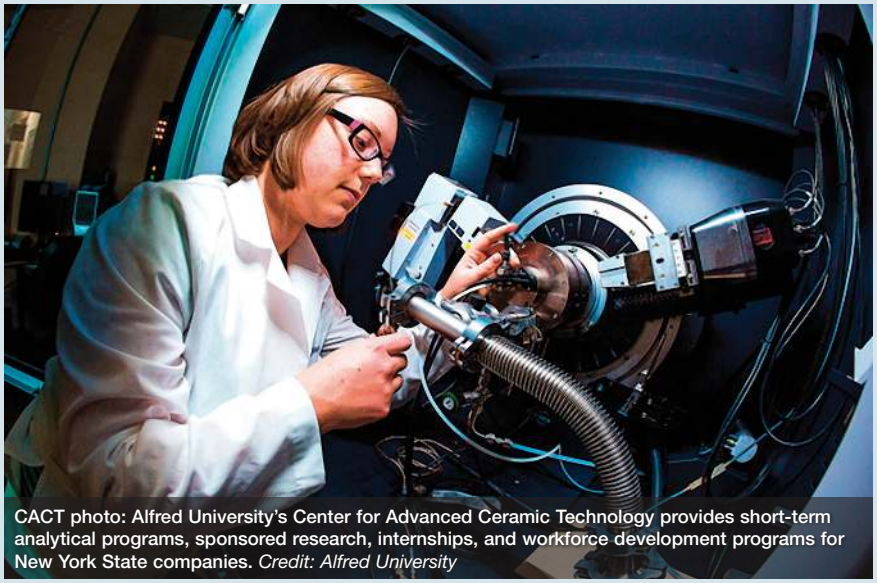
Weber and his small team collaborated with scientists at the Argonne National Laboratory (ANL) Advanced Photon Source, a high-power, radiation light-source research facility owned by the U.S. Department of Energy.

The work was partially funded by a Phase II Department of Energy Small Business Innovation Research award that was completed in 2015, and it resulted in MDI's development of a sample aerodynamic levitation system.

The government support benefits both parties, Weber says. "It's very good funding for this type of work," he explains. "It helps the agency get creative talent from the industry. And it helps us commercialize the technology."

MDI's work was continued at the Spallation Neutron Source at Oak Ridge National Laboratory (ORNL), which provides intense neutron beams for research.

These one-of-a-kind facilities have been integral to MDI's development of instruments to study materials in extreme environments, Weber says.



CACT photo: Alfred University's Center for Advanced Ceramic Technology provides short-term analytical programs, sponsored research, internships, and workforce development programs for New York State companies. *Credit: Alfred University*

"Small business can be very fast-moving and innovative," he says. "But government labs have resources that are unique and specialized, so there's a natural synergy there, in some cases."

The company's access to the high-tech infrastructure at ANL and ORNL was precipitated by networking at professional conferences. Weber recommends that small-business owners and researchers develop relationships with people at agencies that are relevant to their work.

"It's really important to understand what their goals are and to get to know some of the people involved in the program," he says. "Talk to them and learn about where you fit in."

Small businesses are not the only companies that benefit from partnerships and collaborations.

Corning Inc., an $11 billion global concern, holds the Corning Glass Summit every two years to foster collaboration with academicians studying and teaching materials science.

"It's an opportunity to establish closer relationships with professors at various universities in the U.S. and abroad," says Tim Gross, a research fellow at the Corning, N.Y.-based company.

The first Glass Summit took place in 2014 and addressed problems facing the glass science and technology community, identifying research areas of interest to Corning and the industry. In 2016, the Summit explored emerging glass applications, and in 2018, organizers added a poster session focusing on academic research. Post-doctoral researchers, undergraduates, and graduate students presented on glass and materials science topics, creating opportunities for Corning employees to interact with promising researchers early in their careers.

The pandemic canceled the 2020 event, and it was held virtually in 2021, which opened it up to a broader audience overseas.

The Summit helps connect Corning, which employs about 50,000 people worldwide, with students and professors interested in glass science. "The main motivation is to make sure we have a strong talent pipeline," Gross says. "We want to hire people who have a strong foundation in the things we care about."

Fifty universities, government agencies, and professional organizations were represented at the 2018 event.

Corning also sponsors a sabbatical program that offers professors the opportunity to work with Corning scientists on research topics. The Gordon S. Fulcher Sabbatical Program (named for a famed Corning glass scientist) selects one outside researcher per year to participate


Tim Gross

in the program at the company's Sullivan Park research lab. The sabbatical can last from six to 12 months.

New York is also home to a partnership among the state government, industry, and academia. The state funds 15 Centers for Advanced Technology to promote collaboration among private industry and universities. Alfred University's Center for Advanced Ceramic Technology (CACT) was one of the first, having been established in 1987.

"Our mission is to support the growth of industry in New York State," says David Gottfried, the CACT's deputy director of business development. "We offer applied research to help solve short-term or intermediate-term industrial challenges."

The research can range from conducting material analysis to working on multiyear projects to assist in bringing new technologies to the market. "We try to cover the whole spectrum from short-term analytical to long-term sponsored research," Gottfried says.

The Center typically works with 35 to 40 companies a year, on 100 to 120 projects.

The Center also assists with workforce development, sponsoring student internships, and covering half of the cost of their pay and overhead. It also partners with companies seeking to apply for federal Small Business Innovation Research grants.


David Gottfried

The results for business include savings in personnel and equipment costs, and new revenue from commercializing new products. The benefits for the state include the creation and retention of jobs, new capital investment, and additional tax revenue.

A state report found the economic impact of the overall CAT program from 2017 to 2019 to be $25.7 billion, providing an annual return on investment of up to 45 to 1.

That's something Michael Jordan would undoubtedly admire.

How to participate in DARPA's small-business technology and innovation programs

The Defense Advanced Research Projects Agency (DARPA) is an arm of the U.S. Department of Defense responsible for developing emerging technologies for the military. Its mission is "to make pivotal investments in breakthrough technologies for national security." This article was originally published on DARPA's website, https://www.darpa.mil/work-with-us/for-small-businesses/participate-sbir-sttr-program.

PROGRAM HISTORY

Congress established the Small Business Innovation Research (SBIR) Program in 1982 to provide opportunities for small businesses to participate in federal government-sponsored research and development.

The goals of the program are to stimulate technological innovation; use small business to meet federal R&D needs; foster and encourage participation by socially and economically disadvantaged small-business concerns (SBCs), and by SBCs that are at least 51% owned and controlled by women; and increase private-sector commercialization of innovations derived from federal R&D, thereby increasing competition, productivity, and economic growth.

Congress established the Small Business Technology Transfer (STTR) pilot program in 1992 to stimulate a partnership of ideas and technologies between innovative SBCs and research institutions through federally funded research or research and development. The STTR program is a vehicle for moving ideas from our nation's research institutions to the market, where they can benefit both private-sector and military customers.

THREE PHASES OF SBIR AND STTR

The SBIR and STTR programs are composed of the following three phases.

Phase I involves a Department of Defense (DoD) program announcement that seeks contract proposals to conduct feasibility-related experimental or theoretical research and development projects related to the agency's mission. These projects, as defined by agency topics contained in a program announcement, may be general or narrow in scope, depending on the needs of the agency. The object of this phase is to determine the scientific and technical merit and feasibility of the proposed effort and the quality of performance of the SBC with a relatively small agency investment before consideration of further support in Phase II.

Several different proposed solutions to a given problem may be funded. Proposals will be evaluated on a competitive basis using the criteria published in the DoD program announcement. Considerations may also include program balance with respect to market or technological risk, or critical agency requirements.

Phase II continues the research/research and development effort from the completed Phase I. The DoD does not issue separate SBIR or STTR program announcements for Phase II. All Phase I awardees for a given topic will receive notice of when to submit a Phase II proposal.

The agency must base its decision on the results of work performed under the Phase I award and the scientific and technical merit, and the commercial potential of the Phase II proposal. Phase II awards may not necessarily complete the total research and development that may be required to satisfy commercial or agency needs beyond the SBIR or STTR programs. The government is not obligated to fund any specific Phase II proposal.

Phase III refers to work that derives from, extends, or completes an effort made under prior SBIR or STTR funding agreements, but it is funded by sources other than the SBIR or STTR programs. Phase III work is typically oriented toward commercialization of SBIR- or STTR-funded research or technology.

HOW TO PARTICIPATE

DARPA issues SBIR and STTR funding opportunities on a "just-in-time" basis, outside of the three predetermined announcements issued at the DoD level.

Step 1: Determine eligibility. Review complete eligibility requirements at https://www.sbir.gov/about#sbir-policy-directive – Chapter 6: Eligibility and Application (Proposal) Requirements.

For SBA's Guide to SBIR/STTR program eligibility, please search for SBIR Eligibility at https://www.sbir.gov/ (You must use the search function on the top right-hand side of the page.)

Step 2: Find a topic. Review the current and past announcements at https://www.dodsbirsttr.mil/submissions/login to identify topics of interest. On the announcement page, you will find the announcement instructions and topics for each DoD component. Click on the DARPA tab to find the topics and instructions. Be sure to review both the DoD Announcement Instructions and the DARPA-specific Instructions.

Step 3: Ask questions. During the announcement period, communication between small businesses concerns and topic authors is highly encouraged. During the prerelease period, you may have direct communication with a topic author to ask technical questions about their topic. For your convenience, contact information is provided within each topic.

To ensure competitive fairness, direct communication between proposers and topic authors is not allowed once a topic enters the open period (when SBCs are able to submit proposals to DoD). However, during the open period, proposers may submit written questions about open topics via the DARPA SBIR/STTR BAA email address listed in the topic instructions. All questions and answers generated from emails are posted in Q&A documents and published under the topic listing

at https://www.darpa.mil/work-with-us/opportunities and at https://www.darpa.mil/work-with-us/for-small-businesses/proposers-day.

All proposers are advised to monitor these pages during the open announcement period for questions and answers and other significant information relevant to their SBIR/STTR topics of interest.

A soil scrubber to clean chemical warfare agents, left, was developed for DARPA by the Southwest Research Institute, San Antonio, Texas. *Credit: DARPA*

Step 4: Prepare your proposal. All proposals are initially screened to determine responsiveness with submission requirements published in the DoD SBIR/STTR Program Announcement and supplemental DARPA instructions. Proposals that do not comply with the requirements are considered nonresponsive and are not evaluated. Proposals that do comply with the requirements are evaluated by engineers and/or scientists to determine the most promising technical and scientific approaches.

Step 5: Submit proposal. All SBIR/STTR proposals must be prepared and submitted electronically through the DoD SBIR/STTR Electronic Submission website at https://www.dodsbirsttr.mil/submissions and in accordance with the program announcement. Once you begin a proposal cover sheet, you may edit the cover sheet and proposal volumes at any time until the BAA close (or due date for the Phase II proposal). When you have completed your proposal and reviewed it, you must click "Submit Proposal." If the proposal status is "In Progress," it will not be considered submitted upon the announcement close.

TYPES OF FUNDING AGREEMENTS

DARPA administers all SBIR and STTR projects as firm-fixed price, cost plus fixed-fee contracts, and on a case-by-case basis, other transactions (OTs) for prototype.

OTs are instruments other than contracts, grants, and cooperative agreements that are used to stimulate, support, or acquire research or prototype projects.

Intellectual property (IP)

See https://www.acquisition.gov/browse/index/far, reference clause 52.227-11.

And https://www.acq.osd.mil/dpap/dars/dfarspgi/current/, reference clauses: 252.227-7013, 252.227-7014, 252.227-7015, 252.227-7038.

For OTs, the parties are allowed flexibility to negotiate IP because Bayh-Dole does not apply. DARPA normally does not acquire IP rights that will impede commercialization of technology.

EXPORT CONTROL

The following will apply to all projects with military or dual-use applications that develop beyond fundamental research (basic and applied research ordinarily published and shared broadly within the scientific community):

–The contractor shall comply with all US export control laws and regulations, including the International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120 through 130, and the Export Administration Regulations (EAR), 15 CFR Parts 730 through 799, in the performance of this contract. In the absence of available license exemptions/exceptions, the contractor shall be responsible for obtaining the appropriate licenses or other approvals, if required, for exports of (including deemed exports) hardware, technical data, and software, or for the provision of technical assistance.

–The contractor shall be responsible for obtaining export licenses, if required, before utilizing foreign persons in the performance of this contract, including instances where the work is to be performed onsite at any government installation (whether in or outside the United States), where the foreign person will have access to export-controlled technologies, including technical data or software.

¬–The contractor shall be responsible for all regulatory record keeping requirements associated with the use of licenses and license exemptions/exceptions.

–The contractor shall be responsible for ensuring that the provisions of this clause apply to its subcontractors.

Please visit http://www.pmddtc.state.gov/regulations_laws/itar.html for more detailed information regarding ITAR/EAR requirements.