

Ceramic & Glass

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MANUFACTURING

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BREAKING IN: A GUIDE TO WORKING WITH BIG BUSINESS

HOW TO BREAK IN: SMALL COMPANIES CAN USE THEIR STRENGTHS AND FLEXIBILITY

ONE STARTUPS' SECRETS TO BIG COMPANY SUCCESS



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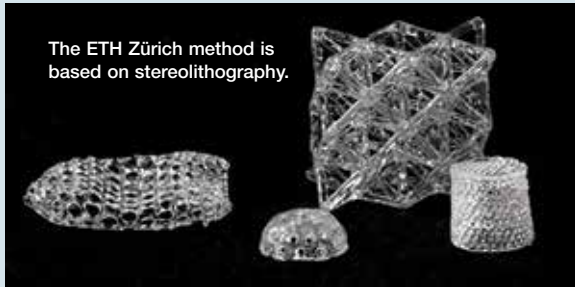
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INDUSTRY NEWS



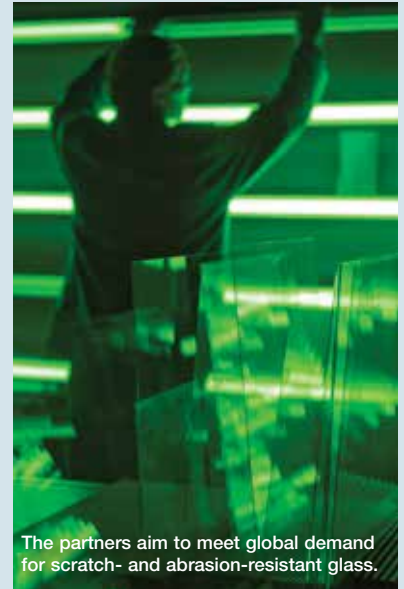
The ETH Zürich method is based on stereolithography.

ETH ZÜRICH RESEARCHERS DEVELOP 3D GLASS PROCESS

Researchers from ETH Zürich developed a technique to produce complex glass objects with 3D printing. The method is based on stereolithography, one of the first 3D-printing techniques developed during the 1980s. The researchers developed a special resin containing a plastic and organic molecules to which glass precursors are bonded. Wherever light strikes the resin, it hardens. The plastic monomers combine to form a labyrinth-like structure, creating the polymer. The ceramic-bearing molecules fill the interstices of this labyrinth.

AGC GLASS USES AI IN NEXT-GEN RESEARCH

AGC Glass Europe, a European leader in flat glass, and Citrine Informatics are collaborating to use artificial intelligence to accelerate the development of next-generation glass. Citrine Informatics is a technology platform that uses AI to bring new materials to market faster and capture materials-enabled product value. The companies said the collaboration will work on ways to meet increasing global demand for strong scratch- and abrasion-resistant glass in the automotive and communication industries.



The partners aim to meet global demand for scratch- and abrasion-resistant glass.

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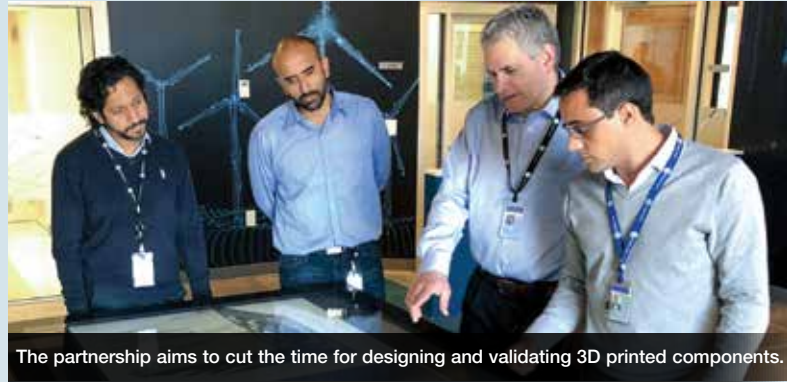
NIST NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY
U.S. DEPARTMENT OF COMMERCE

NEW PRESIDENT OF WORLD REFRACTORY ASSOCIATION



The World Refractory Association elected Carol Jackson, chairman and CEO of HarbisonWalker International, as incoming president of WRA for a two-year term beginning January 2020.

She succeeds Stefan Borgas, CEO of RHI Magnesita, who has led the organization since January 2018. Formed in 2014, WRA has grown from 12 to 22 members in the last two years and has itself become a member of the World Steel Association.



The partnership aims to cut the time for designing and validating 3D printed components.

GE, OAK RIDGE, PALO ALTO PARTNERSHIP AWARDED 3D FUNDING

GE, Oak Ridge National Laboratory, and the Palo Alto Research Center a Xerox company, were awarded an estimated \$1.3 million to accelerate the development of 3D printed turbomachinery parts. The funds were granted by the U.S. Advanced Research Projects Agency-Energy (ARPA-E) Design Intelligence Fostering Formidable Energy Reduction and Enabling Novel Totally Impactful Advanced Technology Enhancements (DIFFERENTIATE) program. Within the program, the partners aim to reduce the timeline for designing and validating 3D-printed components by as much as 65 percent.

CENTER FOR GLASS SCIENCE AND TECHNOLOGY CREATED

By combining materials science expertise with large-scale medical research, Missouri S&T researchers hope to meet clinical demands for glass-related solutions through a new Center for Glass Science and Technology. The new center will build on Missouri S&T's previous glass research, which includes the development of bioactive glass to treat open wounds and cancers. The center was formed with funding from the University of Missouri System, and the grant will provide equipment and dedicated lab space to support research related to the university's NextGen Precision Health Initiative.



Recent research at Missouri S&T targeted bioactive glasses and bioceramics to repair bone, heal soft tissue wounds, and eradicate infection. Credit: Sam O'Keefe/Missouri S&T



Fuyao Group has opened five plants in the U.S.

FUYAO GROUP EXPANDS ITS DAYTON, OHIO, PLANT

China's auto glass manufacturer Fuyao Group said it will invest \$46 million in U.S. dollars in new equipment at its Dayton, Ohio, plant, which will bring 100 new jobs. In 2014, Fuyao bought a former General Motors facility closed in 2008 and turned the abandoned plant into a two-million-square-foot factory. Fuyao Group has opened five factories in the United States. The Dayton factory now has 2,300 employees.



Allied Glass makes containers for Tanqueray gin and many other brands.

ACQUISITION OF ALLIED GLASS COMPLETED

An affiliate of London-based private investment firm Sun European Partners completed the acquisition of Allied Glass for an undisclosed sum. Allied is headquartered in Leeds, England, and is one of the largest U.K.-based manufacturers of glass packaging containers for the premium spirits and food and drinks markets. Sun said the business has doubled its customer base, which includes craft manufacturers and big blue-chip manufacturers, and delivered sales growth of 13 percent per annum.

MORE INDUSTRY NEWS

RHI MAGNESITA ACQUISITION STRENGTHENS ITS NORTH AMERICAN MARKET



RHI Magnesita employs more than 14,000 people.

RHI Magnesita, a global supplier of refractory products, systems and solutions, acquired Missouri Refractories Co., Inc. (MORCO). The acquisition fits into Austria-based RHI Magnesita's strategy to strengthen its position in the North American refractory market, the company said. RHI Magnesita produces more than 400 monolithic mixes, which serve industries including steel, cement, lime, and glass. The company also provides refractory material for the petrochemical industry. The company employs more than 14,000 people in 35 main production sites and more than 70 sales offices around the world.

SUMITOMO INVESTS IN COLORADO-BASED MATERIALS FIRM

Investment and trading firm Sumitomo Corp. of Americas said it would invest in additive manufacturing research and development firm Elementum 3D Inc. Erie, Colo.-based Elementum 3D develops advanced metals, composites, and ceramics for additive manufacturing applications, including a patented metal powder blended with ceramics. Sumitomo said its investment will help the materials firm to expand the sales and marketing of its powder. The powder product will be used in several of Sumitomo's current industries, such as steel, mineral resources, aerospace, and tubular. Sumitomo also recently invested in the additive manufacturing companies Sintavia, AREVO, and Shapeways.



Sumitomo hopes to expand the sales of Elementum's powder product.



Carnegie Mellon researchers will establish an AI Center of Excellence

AIR FORCE FUNDS AI MATERIALS RESEARCH AT CARNEGIE MELLON

The Air Force Research Laboratory's Materials and Manufacturing Directorate awarded a multimillion-dollar cooperative agreement to Carnegie Mellon University to fund cutting-edge research and develop Ph.D. students in an emerging area of materials science: using artificial intelligence and machine learning to discover, analyze, design and develop both existing and new high-tech materials. A kickoff meeting for a Center of Excellence was held in December at Carnegie Mellon.

Medallion Resources' proposed rare-earth plant has a smaller footprint than traditional plants.



MEDALLION RESOURCES TAKES STEP TOWARD RARE EARTHS PRODUCTION

Medallion Resources has engaged international engineering group Stantec to evaluate sites in the U.S. for its planned rare earth element extraction plant. The plant, which will use feedstock sourced from the southeast U.S., will use Medallion's hydrometallurgical process to extract a rare earth element concentrate from byproduct monazite sand. After years of test work and development, Medallion said it recently completed the design of this process. The proposed plant has a small footprint and capital costs that are a fraction of traditional rare-earth mining and processing facilities, according to Medallion.



O-I separated its asbestos liabilities from its glass-making operations.

O-I SUBSIDIARY FILES FOR CH. 11 PROTECTION

Paddock Enterprises, a wholly-owned subsidiary of O-I Glass, filed for Chapter 11 bankruptcy protection under the weight of thousands of asbestos injury claims. In December 2019, O-I created a new holding company structure where O-I Glass became the new parent entity with Owens-Illinois Group and Paddock as direct, wholly-owned subsidiaries. O-I's legacy asbestos-related liabilities are isolated within Paddock, structurally separating them from the company's glass-making operations. O-I Glass and O-I Group were not included in the Chapter 11 filing.

DEPARTMENT OF ENERGY SELECTS EMC FOR SOLAR MODULE DEVELOPMENT

The U.S. Department of Energy Solar Energy Technologies Office selected Energy Materials Corp. to advance perovskite photovoltaic module research and development. The selection supports EMC's scale-up of high-efficiency and stable perovskite solar modules. The project will demonstrate high-speed printing of entire perovskite devices on paper-thin flexible glass, including the transparent conductor layers that are traditionally done by costly vacuum deposition techniques. EMC said the process can greatly lower the cost of building solar panel factories. EMC was selected as a part of the Solar Energy Technologies Office Fiscal Year 2019 funding program.



EMC plans to fabricate the panels on its high-speed, roll-to-roll manufacturing lines.



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May 6–7, 2020 | Cleveland, Ohio, USA

ACerS' inaugural Ceramic Manufacturing Solutions Conference will feature practical programming covering solutions to problems faced by ceramic manufacturers. The program will feature sessions on testing, quality, health and safety, ceramic processing, and raw materials. Registration includes 1.5 days of technical programming, a networking reception on Wednesday evening, and a networking lunch on Thursday. All events occur in the ballroom at the I-X Center in Cleveland, Ohio.

<https://ceramics.org/event/ceramic-manufacturing-solutions-conference>

CERAMIC MANUFACTURING SOLUTIONS CONFERENCE

HOUSTON HOSTS FORUM ON OILFIELD MARKETS AND MINERALS

June 8–10, 2020 | Houston, Texas, USA

Oilfield Minerals & Markets Forum 2020 will be held June 8–10 in Houston at the Hilton Houston Post Oak. Expert speakers will cover key issues and the supply and demand of industrial minerals used in the oilfield market. The forum brings together major players across the global supply chain, from mineral producers, processors, and traders to logisticians, financiers, and end use consumers.

www.imformed.com



MAGNESIUM MINERALS THE FOCUS OF MAGFORUM 2020

May 27–29, 2020 | Noordwijk, Amsterdam

MagForum is for those in the development, supply, processing, logistics, and market application of magnesium minerals. Delegates will have an opportunity to visit the magnesia operations of Nedmag at Veendam on Wednesday, May 27.

www.imformed.com

CHINA'S CHANGING MARKET FOR REFRACTORY MINERALS KEY TOPIC FOR SEPTEMBER EVENT

Sept. 21–23, 2020
Dalian, China

The China Refractory Minerals Forum 2020 will be held September 21–23 at the InterContinental, Dalian. The forum is a networking and knowledge acquisition opportunity on the issues, trends, developments, and outlook for China's

refractory minerals and their market demand domestically and worldwide. There will also be an opportunity to visit China's primary refractory magnesia producing center on Thursday, Sept. 24, in Haicheng, Liaoning. www.imformed.com





81ST CONFERENCE ON GLASS PROBLEMS COMING IN OCTOBER

Oct. 26–29, 2020 | Columbus, Ohio, USA

The Conference on Glass Problems is the largest glass manufacturing conference in North America, attracting manufacturers and suppliers worldwide. The 81st conference will be held October 26–29 at the Greater Columbus (Ohio) Convention Center and is organized by the Glass Manufacturing Industry Council in partnership with Alfred University. The conference focuses on technical issues facing professionals responsible for the operations of glass manufacturing companies.

<http://glassproblemsconference.org>

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HOW TO BREAK IN: SMALL COMPANIES ARE FAST AND FLEXIBLE

By David Holthaus

More than 20 years ago, Joe Pegna and a couple of Ph.D. students at Polytechnique Montreal began working on an advanced manufacturing process to produce high-performance fibers that could be deployed in stressful environments in defense, automotive, energy, and other applications.

By 2006, they had advanced and refined the process enough to start a company called Free Form Fibers.

Today, from the home base in Saratoga Springs, N.Y., Free Form Fibers markets its low-cost, high-performance ceramic fibers to a variety of high-tech customers, touting its status as the only business in the world with the technical capability to produce such materials in a cost-effective way.



Free Form Fibers senior engineer Ram Goduguchinta. Credit: FFF

After starting from scratch in 2006, Free Form Fibers today is a company with seven full-time employees and a list of big clients that buy its products.

"We're the little engine that could," said CEO and co-founder John Schneider. "We've been able to get things done that big guys have spent 35 years working on."

That creative drive to innovate is one of the keys to the company's success. Schneider and others agree it's an important component of growth for any small, high-tech business with an eye on expanding.



John Schneider

As small companies look to break into big markets and grow, they can use the advantages they already have to gain work from their much larger counterparts as suppliers and partners.

Industry experts say capitalizing on the speed and flexibility that small companies enjoy is a way to break into working with the big companies. They can exploit their capacity to quickly conduct research, develop products that fill a void, and scale up production.

"The advantage of small company is flexibility," said Doug Freitag, technical director of the U.S. Advanced Ceramics Association, a trade group that lobbies for the advanced ceramics industry.

That's especially true as big multinational companies tend to look for ways to contain their research and development costs and seek to outsource some of that work.



Exothermics takes delivery of a large plasma deposition system.
Credit: Exothermics

"Little companies can act as almost an outsourced R&D department where the really high-risk stuff can take place," Schneider said.

ONE COMPANY'S BIG BREAK

That's essentially what happened at Exothermics, an Amherst, N.H.-based company that has developed and commercialized nonoxide ceramics, refractory materials, and specialty thin films for use in aerospace, defense and semiconductor markets.

Founded in 1996, the company's growth trajectory took off in 2008 when Lockheed Martin approached it with a problem related to the stealth materials in its F-22 fighter jet.

"We ended up developing something for them that basically solved their issues," said Steve DiPietro, founder and CEO of Exothermics. "That put us on the map."

Exothermics' technology, and its previous relationships with people at Lockheed and elsewhere, got it noticed when the big defense contractor needed help quickly.

It's how productive relationships between large and small companies are often initiated, cultivated, and expanded.

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HOW KYOCERA WORKS WITH SMALLER COMPANIES

Like many other big companies, Kyocera started as a small one. Born in 1959 as the Kyoto Ceramic Co. with 28 employees, Kyocera is now a global giant with more than 75,000 employees and sales of more than \$14 billion.

Some of its growth over the years has come through partnerships with small companies, as well as acquisitions, and company executives say they are always looking over the horizon for new technologies and applications.

"We are reading articles, we go to trade shows and conferences, we read patents," said Mark Wolf, vice president of Kyocera's Fine Ceramics Group. "Anything that small companies do that's public,



Mark Wolf

advertising what they have, we're generally going to pay attention to."

Like all big tech companies, Kyocera has a substantial research and development budget, but the company can't do everything on its own, so it looks to small firms to supplement its own work.

"We're interested in new materials, new methods and processes, new equipment," Wolf said.

The company's R&D team explores emerging technologies in new markets and attempts to solve challenges that arise from relying on conventional materials, said Jay Scovie, deputy general manager for corporate communications at Kyocera.



Some of Kyocera Fine Ceramics' products. Credit: Kyocera

A champion for large and small manufacturers

Large and small ceramics manufacturers alike have a friend in Washington in the U.S. Advanced Ceramics Association.

Based in D.C., USACA is an organization that champions the business interests of advanced ceramic producers and their industry customers.

The association was formed in 1985 to facilitate the commercialization of the United States' advanced ceramics industry and has become a leading voice of the industry before the U.S. Congress and federal agencies.

USACA and its member companies work to identify new commercial market opportunities for advanced ceramics and promote their use in new high-efficiency and high-performance products for transportation, aerospace, defense, energy, and industrial applications.

The organization functions through working groups led by USACA members. It establishes working groups on an as-needed basis and currently staffs groups in ceramic fiber and ceramics matrix composite manufacturing, nuclear ceramics, transparent armor, and workforce development.

USACA will hold its 45th annual conference on January 25–28, 2021.

More information about USACA is available at advancedceramics.org.

For example, in mid-2019, Kyocera announced an expanded partnership with Cambridge, Mass.-based 24M to validate that company's manufacturing platform to mass produce a semi-solid lithium ion battery system.

Then in January, the two companies announced the launch of a residential energy storage system using 24M's new manufacturing process.

"24M and Kyocera working together will do something that neither company could do on their own," Scovie said.

The two companies have been long-time partners and Kyocera has been an investor in 24M for some time.

It's the type of business relationship that evolves and grows over time and is typical of how Kyocera and other big companies interact with small firms.

Kyocera will fund research and capital investment at small firms in order to be at the head of the line when it comes to commercializing the company's technology.

"We really like to work with companies first to get to know them before we do anything else," Wolf said.

Sometimes, Kyocera will simply fund good, small-company ideas. In other cases, especially where intellectual property issues may arise, it will enter into joint development contracts, Wolf said.

"I've paid companies millions of dollars to direct their R&D in a direction that Kyocera wants," Wolf said.

Sometimes these arrangements result in acquisitions, as Kyocera staff has opportunities to see what the culture of the small company is like, how its staff works, and what their capabilities are.

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HOW TO MINIMIZE PERCEIVED RISKS

While small companies can be fast and flexible, they can present risks to big corporations, Freitag said. And small-business owners should take steps to minimize those risks.

Small companies should anticipate thorough reviews before the big companies agree to do business with them, he said. This review often takes the form of an audit of the small firms' manufacturing systems, employee capabilities, finances, and other measurements.

"The big companies are very risk averse," Freitag said. "The last thing they want to do is spec your ceramic material into a system then have that company fail."

Free Form Fibers and other companies are compliant with the guidance and recommendations of the Defense Contract Audit Agency, the agency responsible for auditing government defense contracts. Compliance means documented policies and procedures are in place and rigorously followed to meet the government's requirements.

"Good, strong bookkeeping is as important as excellent technical work for small companies and startups, just as it is for larger organizations," Free Form's Schneiter said.

There are programs in place to assist small companies in working with the bigs. One is the Department of Defense Mentor-Protégé program, under which small businesses are partnered with larger companies. It's designed to help small businesses expand their footprints in defense industry work.

"It helps them put into place everything they need to be a good supplier to a big company," Freitag said.

The DOD said the program has helped more than 190 businesses become part of the military's supply chain.

The DOD also maintains its Title III program, which provides funding to ensure domestic industrial defense capabilities, commercialize research and development, and scale up emerging technologies. The program has been in existence since the 1950s and has helped many small businesses transfer technology to prime contractors, Freitag said.

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Defense department officials regularly issue requests for information that could lead to opportunities for small companies. For example, in November 2019, the department issued a request for information on producing ultrahigh and high-temperature composites for hypersonic and strategic systems, and in December it issued a call for proposals to strengthen the industrial base for the production of light and heavy rare earth elements.

One CEO's secrets to success

Steve DiPietro, founder and CEO of Exothermics, offers these tips on working with big companies:

1. Building relationships with a larger company is all about building trust and credibility. This can take some time if you are coming in as an outsider.
2. It's good to find a difficult problem to work on.
3. You must believe in your proposed solution to the problem and be willing to spend painful amounts of your own money to get there.
4. Over the long haul, it is good to have one or more champions for your cause on the inside.
5. You must have a long-term horizon that is not exclusively focused on revenue or profits. You need to have a Pope-like perspective on helping your customer. The profits will come later.
6. Become part of the larger company's long-term development strategy and planning. This integration gives you insight into future areas of interest for collaborative product development and revenue generation.
7. Be willing to accept some of the administrative and bureaucratic requirements that are imposed by essentially all large DOD/aerospace and even commercial concerns (e.g., quality management systems such as ISO, AS9100, SAP systems, liability insurance). These requirements are just a carrying cost for working with large firms.
8. One of the main challenges is to become like a junior version of a large company while not loading up with the administrative overhead that slows things down. In the eyes of the large company, the value of working with a small company is that they have the opportunity to work with someone that can move rapidly with the minimum level of administrative overhead. You need to engage in a balancing act that preserves the character of your entrepreneurial vision while offering an acceptable mechanism for the large company to work with you.

Small companies can use their speed and flexibility to respond quickly to such opportunities, Freitag said.

Once a small company gets connected to a big one, maintaining that relationship and cultivating trust among people on the inside will help create long-term opportunities, DiPietro said. "That's what's of enduring value—when you have champions on the inside," he said.

But he cautions small companies to maintain the traits that led to their success in the first place, even as they work with multinationals that will make many demands on them.

"You're being faced with a set of bureaucratic requirements that you have to manage," he said. "You have to actively push back and not allow your company to be a clone of a Boeing or Lockheed or a Ford or a GM. Preserve those things in your corporate culture that contribute to your creative spirit and lack of bureaucracy." ▽



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A SHORT LIST OF RESOURCES AVAILABLE TO SMALL MANUFACTURERS

There are many resources and programs available to small businesses through the U.S. Small Business Administration, the U.S. Department of Commerce and others. These programs have been cited as especially relevant to small, high-tech manufacturers:

SMALL BUSINESS INNOVATION RESEARCH (SBIR) PROGRAM

A competitive program that encourages domestic small businesses to engage in federal research and R&D with the potential for commercialization.

<https://www.sbir.gov>

SMALL BUSINESS TECHNOLOGY TRANSFER (STTR)

A federal program that requires small businesses to collaborate with research institutions to bridge the gap between basic science and commercialization of resulting innovations.

<https://www.sbir.gov/about/about-sttr>

PROCUREMENT TECHNICAL ASSISTANCE PROGRAMS

Established to expand the number of businesses participating in government contracts. Administered by the Defense Logistics Agency's Office of Small Business in cooperation with states, local governments and nonprofit organizations.

<https://www.dla.mil/SmallBusiness/PTAP>

DEPARTMENT OF DEFENSE RAPID INNOVATION FUND

A vehicle for small businesses to provide the department with technologies that can be rapidly inserted into acquisition programs that meet specific defense needs. Administered by the Office of the Secretary of Defense, Assistant Secretary of Defense for Research and Engineering and Office of Small Business Programs.

<https://defenseinnovationmarketplace.dtic.mil/business-opportunities/rapid-innovation-fund/>

DEPARTMENT OF DEFENSE MENTOR-PROTÉGÉ PROGRAM

The oldest continuously operating federal mentor-protégé program in existence. Helps eligible small businesses expand their footprint in the defense industrial base by partnering with larger companies.

<https://business.defense.gov/Programs/mentor-protége-program>

SMALL BUSINESS ADMINISTRATION'S ALL SMALL MENTOR-PROTÉGÉ PROGRAM

Mentors and protégés in the All Small program can form joint ventures. These joint ventures would qualify for set-aside contracts that the small business is eligible for.

<https://www.sba.gov/federal-contracting/contracting-assistance-programs/all-small-mentor-protége-program>



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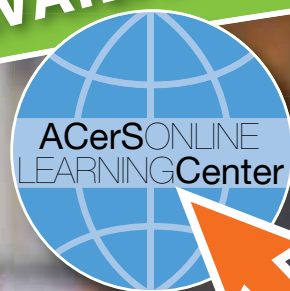
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