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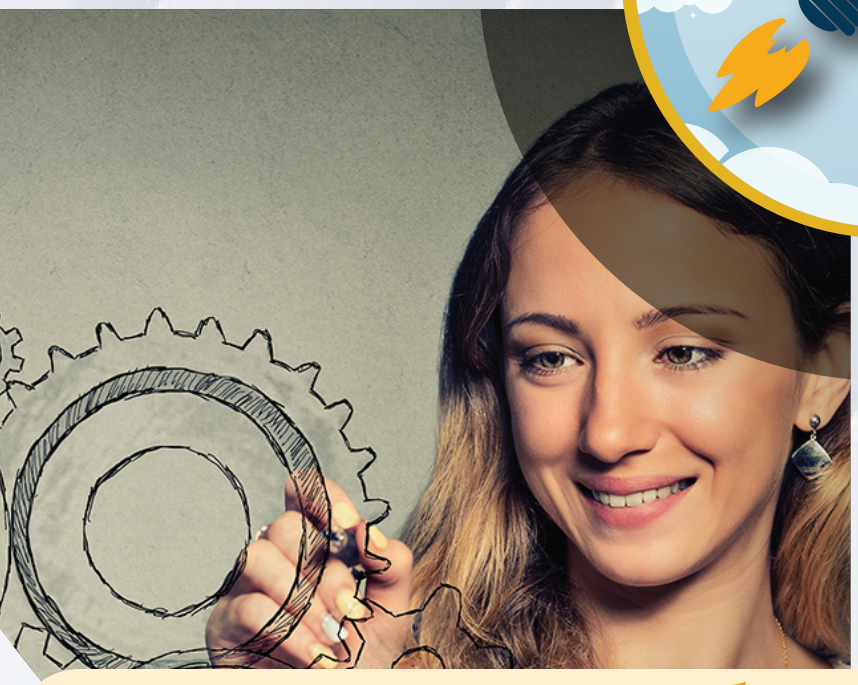
Pittsburgh ENGINEER

Quarterly Publication of the Engineers' Society of Western Pennsylvania



entrepreneurship in engineering

Michael Baker
INTERNATIONAL

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Pittsburgh
ENGINEER
Quarterly Publication of the Engineers' Society of Western Pennsylvania

In this Issue...

ESWP ENTREPRENEURS

Throughout this issue of the Pittsburgh ENGINEER you will find additional content by ESWP members who have shared their entrepreneurial experiences - Enjoy!

ESWP 1880 ENGINEERS' SOCIETY of WESTERN PENNSYLVANIA

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Guest Editor Column

By: John Blazosky, P.E.

John Blazosky

Like nearly all graduating engineers, one starts by performing small tasks to learn your craft. You progress as part of a team and make project engineer or manager. Along the way, some engineers have an idea, an invention, or a solid reputation. And since you operate in a business environment, you begin to think of yourself as an entrepreneur.

In this issue engineers of different backgrounds talk about their entrepreneurial experiences. Collectively these articles portray some commonality about what it takes to start something new.

So many different routes can lead you in an entrepreneurial direction. But how do some folks cross over to that world, start a business and take on financial risk? Well, I believe that while some engineers may have always had that desire, most of us grow into it. We are good at our craft, we evolve as a leader, the opportunity presents itself, and you go for it!

In my case I had no real motivation to start a business. I was pretty much my own boss at a small consulting firm. But faced with having to relocate and clients urging me to do a start-up, I did so in the living room of my house. It took a couple of years to gain confidence, but my best clients became my champions and my mentors. What a bonus for me to be paid while learning!

So the first lesson is to be very good at what you do. We deal in the technical but customers are savvy at seeing through the engineer who tries to do the old soft shoe. And while one may be technically proficient, "good" also means that you can relate especially well to people. Engineers take note and self-evaluate!

The next hurdle is how do you learn business? Well if you are going for the big business with a product and investors, you better get an MBA or a partner that has one. But if you are starting a more typical small engineering practice in my opinion, it's not so much about an MBA. At this level, business is more akin to having "street smarts". Pick up the MBA when you grow into it or if you need it for your own confidence.

Not to worry however, you can learn business from your mentors-the real key to success. Some folks have clients that help them, like I had. Others establish an effective board of directors. And many turn to the numerous business resources available, such as SCORE in which I now mentor others.

Hence the second lesson is to seek mentors. The biggest help mentors provide is the push they give you to stay focused and organized. Too many people have too many grand ideas that lead in way too many directions. Stay focused! Everyone needs a business plan anyway to put your dream in text, to gain a line of credit and to plot your progress.

All of this is a good start but for one other big stumbling block….financial risk. Now the desire to make money could have been said up front, but it would likely have turned off too many readers. Perhaps it may be why most well qualified folks stop here. But in your decision matrix, the thought of making money better be there. It should not be an afterthought. Providing for your family, financial security, and having a plan to retire are all good reasons to want to make money.

Lesson three is to be sure you make money. Without this basic but seldom stated out loud raw fact of business life, nothing stated above works for very long. Now don't get me wrong, there are certainly many forms of satisfaction from running a business. Certainly, providing for your employees and their families is extremely motivating and rewarding in and of itself. But you are taking the risk, without a guarantee, and you need to be rewarded. Starting a business requires an enormous allocation of time and energy that could be used elsewhere. Don't short-change yourself!

Finally as I noted above, I have worked in SCORE for a couple of years as part of my personal repurposing plan. As a voluntary resource partner of the U.S. Small Business Administration, our local SCORE chapter mentors more than 65 clients a month who either have an established business need or who want to start one. It is immensely rewarding to kindle that entrepreneurial spirit sparked in yourself many years ago. If after this edition's read, you are encouraged to start a business or if you want to assist others in seeking their business dreams, please use the following link to find out more: https://pittsburgh.score.org/

Wishing you success,

John

Robotics startups in Pittsburgh are taking off

ENTREPRENEURS LOOK TO THE SKY FOR NEW MARKETS

BY: BYRON SPICE

Entrepreneurship in Pittsburgh has become almost synonymous with self-driving cars, thanks to pioneering work at Carnegie Mellon University, the rise of Uber as a technology developer, and the launch of well-funded startups such as Argo AI and Aurora Innovation.

A growing number of robotics companies in Pittsburgh, however, are literally taking flight. Led by Astrobotic Technology, which has set its sights on the Moon, companies here are developing technologies that will enable aerial autonomy and space exploration.

"Robotics is a key driver for the future of space science & exploration, satellite servicing, in-space manufacturing, proximity operations, and the development of our Moon," said John Thornton, CEO of Astrobotic, which spun off of CMU Robotics Institute in 2007. "It is no surprise that Pittsburgh, the home of the world's best robotics talent, is becoming a hub of activity for the aerospace sector."

Although Astrobotic stands alone locally in its focus on space, the region's aeronautics startups also are displaying their technological chops. Notably, the Robotics Institute and another of its spinoffs, Near Earth Autonomy, shared the Howard Hughes Award from AHS International, The Vertical Flight Technical Society, and a nomination to aviation's most prestigious award, the Collier Trophy.

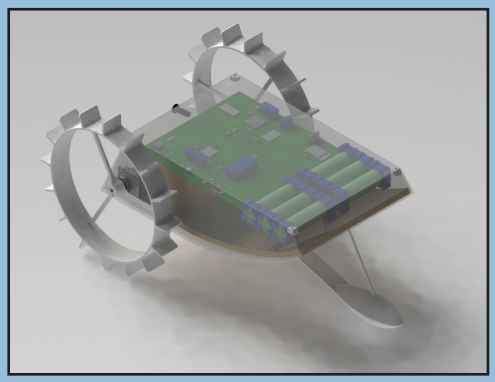
Both awards cited them as part of the team that developed the Office of Naval Research's Autonomous Aerial Cargo/Utility System (AACUS), a fully autonomous helicopter flight capability.

"AACUS is a dream project that leveraged decades of research in perception and planning for autonomous flight," said Sanjiv Singh, a research professor in the Robotics Institute and the CEO and co-founder of Near Earth Autonomy. The company develops technology for autonomous flight ranging from the full-size helicopters used in the AACUS project to sub-meter rotorcraft.

"This project was particularly inspiring because it investigated the art of the possible for autonomous flight," he said of AACUS. "We expect that this technology will go to the future of autonomous flying passenger vehicles and the cargo air vehicles." Near Earth Autonomy already is working with companies such as Boeing and Airbus, to develop flying cars and other forms of urban mobility, he noted. "This technology will revolutionize the way we move people and goods."

Drone technology is part of the business plans for a number of area companies:

- Identified Technologies specializes in drone mapping, particularly of construction sites.



The CubeRover, shown here in an artist's rendering, is being developed by Astrobotic Technology and Carnegie Mellon University with support from NASA. The small, relatively inexpensive robot is intended to make extraterrestrial exploration accessible to universities, corporations and nations without a space program.

The Office of Naval Research's Autonomous Aerial Cargo/Utility System, or AACUS, is a package of sensors and software that can be integrated into an existing rotary-wing aircraft, such as this UH-1 "Huey," to provide autonomous capabilities. Pittsburgh's Near Earth Autonomy was a key member of the AACUS team.

An autonomous helicopter project team that included researchers from CMU Robotics Institute spinoff Near Earth Autonomy has won the 2018 Howard Hughes Award from AHS International, The Vertical Flight Technical Society.

In this artist's rendering, a team of CubeRovers is deployed on the Moon by an Astrobotic Technology Peregrine lander.

- Nabla Ascent, a CMU student startup, is developing autonomous drone technologies, including obstacle avoidance.
- Skycision specializes in drone applications for farming.
- Steel City Drones specializes in drone photography, mapping and inspection services

Astrobotic was founded by Red Whittaker, professor of robotics at CMU and a serial entrepreneur, to work with the university in pursuit of the Google Lunar XPrize, a $30 million contest to put a robot on the Moon. However, long before that contest was discontinued, Astrobotic developed a business plan to develop hardware and fly missions that will enable companies, governments and universities to explore the Moon.

Among its current projects is the development of a new class of small, lightweight extraterrestrial robots, called CubeRovers. The company is working with Whittaker and the Robotics Institute with support from a Phase II Small Business Innovation Research contract with NASA. Whittaker compares the small rovers, which weigh no more than two kilograms, with CubeSats, the small, inexpensive satellite platforms that expanded access to low earth orbit for many researchers two decades ago.

"CubeSats revolutionized the frequency and economy of missions to orbit," said Whittaker, who is chairman of Astrobotic. "CubeRovers will similarly revolutionize surface exploration. In planetary robotics, small is the next big thing."

ESWP ENTREPRENEURS

Lennon, Smith, Souleret Engineering (LSSE) provides civil-water resources, civil-municipal, and civil-site engineering, surveying and GIS services.

What markets does your business serve?
LSSE's predominant market is the local municipal government market including Municipal Authorities, Townships, Boroughs and Cities. Services are also provided to a lesser extent to the private land development market.

How old is your business?
LSSE was founded in June 1985 and is approaching 33 years of service.

How many employees?
LSSE currently employs a staff of 80+ and growing

What were the biggest hurdles at start up? later?
In the first year or two as a start-up engineering firm, we had to rely heavily on the existing solid reputations of our founding partners. This carried us only so far, and it took patience to get through those first years, so that by years 3 -5 we were able to demonstrate the reliable, high quality services of the firm and transfer personal reputations to the organization's reputation. Managing growth over the longer term was a challenge in balancing hiring and mentoring new employees to match not simply workload but also client expectations of performance.

What have been the greatest rewards?
On a company management level, watching the company grow organically based on high quality repeat work, client referrals and the reputation of the company and, most importantly, our dedicated employees. On a personal level, the ability to have a direct positive impact on community quality of life and our environment.

Lawrence J. Lennon, P.E., D.WRE

What advice would you give someone contemplating starting a similar business now?
First and foremost develop a genuine interest in and devotion to your work and your profession, provide a consistently high quality work product, be willing to put in the effort (60+hours per week), be prepared for lean years, stay upbeat in the face of rejection (rejection will be a fact of life), maintain an insatiable curiosity to learn new things and support your staff to learn new methods and stay current with technology, never lose sight of your ethical responsibilities. Embrace, share, and enjoy every minute of your professional career.

Have you ever needed to vet the question of acquisition? What weighed into your decision to continue as the owner?
Yes, multiple times throughout the years. Our decisions to remain Owners were based on a number of considerations including continuity of service, loyalty to clients and employees, financial benefits, concern for cultural differences between acquired/acquiring firms, loss of small firm personal impact decision making, and dedication to our preferred internal Ownership transition plan.

ESWP ENTREPRENEURS

KENNETH A. CRAWFORD, P.E., CIVIL ENGINEERING CONSULTANT is a civil engineering firm located in New Kensington, PA

What markets does your business serve?
Civil Engineering Consulting, Technology Training in the Architectural, Civil, Surveying and Construction Industries

How old is your business?
3 Years

How many employees?
One

What were the biggest hurdles at start up? later?
Securing babcklog of work, new project assignments

What have been the greatest rewards?
Travel (domestic and internation), ability to set own schedule and decide what type of work to pursue

Ken Crawford, P.E.

What advice would you give someone contemplating starting a similar business now?
Be willing to work very hard, but know that it will be hard work that you will enjoy, and it will pay dividends every step along the way. Be well funded, or in a position to absorb lean times (line of credit, savings, etc.) PAY YOUR TAXES!!

SAVE THE DATE!

Join us in Bethlehem • October 1-3, 2018

2018 Pennsylvania Brownfields Conference

The Sands Conference Center is the center of this premier destination located in the Lehigh Valley at the Bethlehem Steel brownfield. The Pennsylvania Department of Environmental Protection hosts the conference in partnership with the Engineers' Society of Western Pennsylvania

Visit https://eswp.com/brownfields/overview for more information

ESWP ENTREPRENEURS

Tammi Halapin and Coreen Casadei

Collective Efforts, LLC, is a Certified WBE providing Civil and Environmental Engineering Services Civil and environmental consulting services

What markets does your business serve?
Infrastructure, Water, Transportation, Industrial, Municipal

How old is your business?
18 years old

How many employees?
16 employees and growing

What were the biggest hurdles at start up? later?
At the start, our biggest hurdle was that we started at Ground Zero. We left a large engineering firm and did not bring any clients along. It took several years to build a client base. We also did not put enough value on the experience we already had gained before starting our firm.

Later, our biggest hurdles centered around business management decisions such as how and where to lead your firm. Also, getting paid in a timely manner became a large hurdle many times through the years. When you are a subconsultant, you are not in control of when you get paid.

What have been the greatest rewards?
One of the greatest rewards is that you are in control of your own destiny and you get the opportunity to attempt many things. Being an owner also allows some flexibility in your life and schedule. You can open doors that you may not have been able to if working at a firm as an employee. You get to directly benefit from your hard work. You also get the chance to meet a lot of interesting people in your field.

What advice would you give someone contemplating starting a similar business now?
Advice for someone starting a similar business today…. have patience, passion and persistence to start. Plan on a ton of networking and teaming. Don't be afraid to talk to new people and to promote your firm and your experience.

Have you ever needed to vet the question of acquisition? What weighed into your decision to continue as the owner?
Yes we have been asked a few times about acquisition. We didn't feel that the time was right; we haven't had enough time yet building our company to the best it can be. We still wanted to be owners. Five years from now, come talk to us!

NEW THIS YEAR!

ESWP has partnered with the University of Pittsburgh's Energy Grid Institute to present the Electric Power Industry Conference (EPIC).

Check the ESWP website for details on registration, exhibiting, sponsorship and more!

SWP ENTREPRENEURS

Graves Design Group, LLC. (GDG) is a full-service design firm that offers architectural/engineering, interior design, design/build, and graphic services. We have served a variety of public, private, and non-profit clients since 1988 with a primary specialization in educational facilities, parking facilities, and residential. We also design office and retail, commercial, entertainment, historical restoration, Green/LEED, and government projects. GDG has the capability of managing several projects simultaneously; any one of which may range in construction cost from under $100K to $ 30 million or more.

The success of GDG has not come easy. As for most firms who have been in businesses for 30 years, there have been many bumps in the road and learning opportunities. But, that is part of being an entrepreneur; taking the initiative to run a profitable business with the passion and energy to deliver a service or product to customers. And, the willingness to assume the risks involved along the way towards reaching that goal. Having an architectural degree from CMU, a prestigious design university was not enough. I learned that to be successful in business, I also needed to hire people with the business acumen to help me run my firm and advise me on areas outside my core focus (architecture). In my hiring of a business manager, accountant, attorney and other key professionals, helped to solidify the firm in areas that had been lacking. This equipped GDG with the necessary tool(s) and skill set for preparing a tailored management structure to respond to the dynamic business environment. As a result, we had crafted a 5-Year Business Plan to set in place a "living guide" to help us navigate our course, partly through continuous assessment of our Strengths, Weaknesses, Opportunities and Threats (S.W.O.T). Also, in checking the pulse and making needed adjustments to the plan in response to current /projected market conditions.

GRAVES DESIGN GROUP, LLC.
Architecture • Interior • Design/Build • Graphics

That said, I learned not to be afraid to loosen-up on taking chances, but, more importantly not to be afraid to lose something in the process. With rare exception, it takes a team of talent individuals to deliver success in business. Everyone on staff is hired to contribute to the success of the business and are, thus, considered an important cog in the wheel that keeps it rolling smoothly.

Howard K. Graves, Architect is the President of Graves Design Group, LLC/ Graves Architects, Inc. Learn more at http://www.gravesdesigngroup.com/

VOLUNTEERS NEEDED !

SCORE is a nonprofit association dedicated to helping small businesses get off the ground, grow and achieve their goals through education and mentorship. We have been doing this for over fifty years. For those looking to give back to our community we have the following roles available:

- Business Mentors
- Workshop Instructors
- Subject Matter Experts (e.g., social media, finance, fundraising, retailing, or administration)

Individuals interested in finding out more, or to volunteer please contact: Mark Fallek at mark.fallek@scorevolunteer.org or through our website www.pittsburgh.score.org

SCORE Pittsburgh
FOR THE LIFE OF YOUR BUSINESS

ESWP ENTREPRENEURS

Brashear Construction Consulting, Inc. (BCC) provides consultative services to contractors, developers, engineers, attorneys, and other construction project stakeholders. We are most often engaged in matters involving construction claims, including builder's risk, professional liability, subcontractor default insurance, and surety bonds as well as requests for equitable adjustments and project schedule analytics. Our team specializes in forensic delay analysis and CPM scheduling.

We have assisted in the closure of matters involving construction claims totaling over $2.41B with individual claims ranging from $750K to $175M.

What markets does your business serve?

We work in all sectors of construction, including commercial, industrial, healthcare, residential, retail, educational, institutional, energy and power, infrastructure, sports and entertainment. We serve the needs of all project stakeholders but specialize in providing timely and concise solutions for complex and daunting matters.

How old is your business?

Our company is entering its 11th year of operation.

How many employees?

We have 10 full-time employees and 11 part-time employees.

What were the biggest hurdles at start up? later?

At our company's inception, we had 1 employee, Tim Brashear, P.E., the founder and owner of our firm. Over the years and as business evolved, we steadily grew and had to begin recruiting, hiring and training new talent in a specialized claims industry. Along with that growth, the company had to learn how to develop policies and procedures to take commonalities and practices and turn them into standardized processes. We also had to learn how to balance our daily work tasks with the overhead tasks typically occupied by Human Resources, IT, Accounting, etc. All of our employees came from large corporations where they previously tasked individual departments with certain overhead tasks. For our small business, that wasn't the case. This was a big hurdle to overcome and we continue to look for ways to streamline these processes and operate in a lean mindset.

What have been the greatest rewards?

We really value our employees and have a vested interest in their personal and career goals. One of our greatest rewards was being able to structure our operations around a work from home, 40 hour work week and provide a zero dollar deductible premier healthcare package to our employees at no additional cost to them. Knowing that our employees take home a pay check bi-weekly without premium sharing deductions for healthcare is very fulfilling and rewarding for our company.

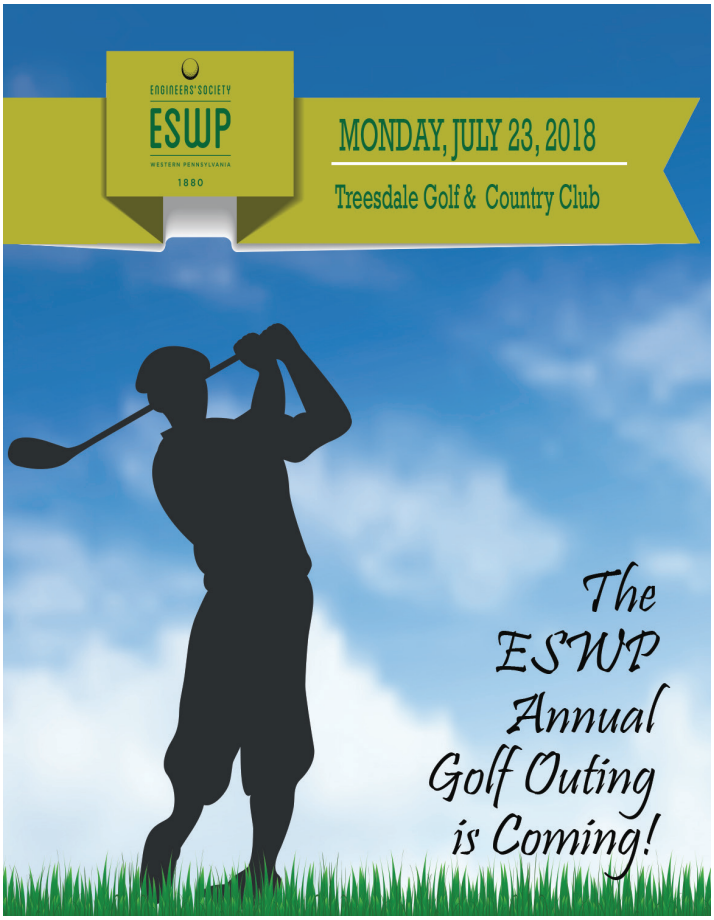
What advice would you give someone contemplating starting a similar business now?

Consultants are a dime a dozen in the construction industry. What sets you apart is your customer service, competitive pricing, knowledge and level of professionalism. You have to be able to build a team of professionals that shares your goals and personal drive. We believe that we are only as good as the people around us, and building that team is of upmost importance to the success of your company.

Timothy Brashear, P.E.

Have you ever needed to vet the question of acquisition? What weighed into your decision to continue as the owner?

Over the years, we have received several offers for acquisition. As a consulting company, with our largest asset being our employees, it is challenging to identify a valuation that properly accounts for that intangible asset. Outside of the valuation challenges, we have also been faced with acquisition offers that do not include bringing along the entirety of our team. At every acquisition opportunity we are always up front and insistent that any offering must include the continuation of our team's employment, no exceptions. We are successful today because of our people, and we see every acquisition as an "all or nothing" decision when it comes to our people. Without our team of talented engineers, attorneys and construction professionals, we would not be celebrating our 11th year of business.



ESWP Member News

More than 75 firms are represented in the Corporate Member program of the Engineers' Society of Western Pennsylvania (ESWP). Corporate Memberships are available at 3 levels: Gold, Silver and Bronze. Gold members are entitled to 14 memberships that can be exchanged by employees; Silver, 9; and Bronze, 5 — annual dues are $2400, $1700, and $1000 respectively. In addition, ESWP Corporate Member Firms may add 2 additional individuals in our Under-35 age category at no additional cost!

We also offer Individual Memberships, including a new "Under-35" category, which allows for full member privileges at annual dues of $25 and a Government rate (full-time), with for $50.00! Also, our new Dining Membership allows use of the Executive Dining Room for conducting client entertaining in a great private club setting, all for only $50 annual dues, plus regular entry fee. More information can be found at eswp.com. Please contact the ESWP Office (412-261-0710) for additional details.

Membership in ESWP comes with a long list of benefits! From our continuing education opportunities earning you Professional Development Hours (PDHs), to the business networking events in our Executive Dining Room, there is something for everyone in your organization. Also, ESWP is helping the next generation of engineers with student outreach programs, giving you the opportunity to participate in many rewarding programs.

ESWP Gold Corporate Member Firms

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transforming ideas into reality

ARCADIS
Infrastructure · Water · Environment · Buildings

Michael Baker
INTERNATIONAL

GATEWAY
On Call. On Time. On Target.

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DIGIOIAGRAY
CONSULTING ENGINEERS & SCIENTISTS

HATCH

solutions21

DEI
DeSalvo Enterprises, Inc.

HDR

TeleTracking
Workflow Automation for Healthcare.™

ESWP Silver Corporate Member Firms

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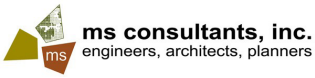
ESWP Bronze Corporate Member Firms



SWP ENTREPRENEURS

Aquatemp Global designs and manufactures to order quite long (500 to 2000 feet) multi-conductor cables which bear sensors embedded into the interstices or in some cases on a 6 inch lead external to the cable, for determining water conditions in rivers, oceans, lakes etc, with data loggers on shore. Deepest: 650 feet vertical assembly with anchor and subsurface float 800 ft offshore Lake Superior.

What markets does your business serve?
Public Utilities, drillers, Marine Institutions, U.S. Navy, Defense Contractors, large water districts

How old is your business?
Continuous since 1971 when I invented the manufacturing technique

How many employees?
Three all the time, when a system gets built sometimes 10 to 12 for installation work.

What were the biggest hurdles at start up? later?
Location to unreel cable and re-reel after sensors inserted,. We once wrapped cables around my home in ft. Lee N.J. in 1972 in order to get at the end.

What have been the greatest rewards?
No mortgages on employees homes. And satisfaction for improving water.

What advice would you give someone contemplating starting a similar business now?
Network inside the industries you serve. Manufacturing Secrets (MS) are better than patents which expire in 20. MS Never expires.

John Lenkey of Aquatemp Global

Have you ever needed to vet the question of acquisition? What weighed into your decision to continue as the owner?
We are at the present time seeking to put one or two companies into our unique business to continue the technology as my partner - the manufacturing guy, and me - the engineer are both very old and would like to end hefting large cable reels on and off jack stands at our LaVale, Maryland production location, when in production. We will fully teach and coach and be available for the transition. Acquirer simply buys one or more portable injection molding machines and already cut molds and we teach marketing, sales, design considerations, production and installation techniques. Since no other company can do what we can, the margins are very pleasing.

I do the design work in Oakdale, PA about 11 miles from downtown Pittsburgh.

SWP ENTREPRENEURS

RIZZO INTERNATIONAL, INC. is an international consulting engineering and geoscience services firm. We view the entire world as our market and have worked in about 100 countries. Over the past two years, we have been active throughout the USA, in the Middle East, Korea, India, Turkey, Iraq, China, South Africa, Czech Republic, Hungary, Slovakia, Russia, UK, Qatar, UAE, Sri Lanka, Mexico, Canada, Switzerland, Italy and Slovenia.

What markets does your business serve?
Dams and Power Plants worldwide, particularly nuclear plants as supplied by Westinghouse, Rosatom, KEPCO, AECL and NuScale,

How old is your business?
We have been in the engineering consulting business for 34 yrs. During 2017, we transitioned all the activities to RIZZO International, Inc, a women-owned small business

How many employees?
The number varies with Project Load, particularly overseas. We currently are about 200 people if one adds up all of our overseas offices and projects.

RIZZO INTERNATIONAL, INC.

What were the biggest hurdles at start up? later?
The biggest hurdles at the beginning and always are financial as the margins in the engineering business are relatively “thin,” and in general clients tend to pay engineers very slowly and some clients do not pay the full cost of the work.

What advice would you give someone contemplating starting a similar business now?
You should expect to work long hours with a great deal of stress plus more travel than you like if you plan to work around the world.

Have you ever needed to vet the question of acquisition? What weighed into your decision to continue as the owner?
We deal with this question almost monthly from many suitors from all over the world. We have always decided to remain independent and to be our own “bosses,” especially now that we have transitioned the management and ownership to the next generation.

In the very beginning of the business, this was also the motivator—to be our “bosses” and to be fully responsible for our respective futures.

Jumping into Entrepreneurship as an Engineer

– Observations and Tips

By: Francois Gau

“Success consists of going from failure to failure without loss of enthusiasm”
...Winston Churchill

Why do some engineering enterprises succeed while many others fail? Examples abound of great engineering ideas that have made it: Airbus, Boeing, SpaceX, Harley Davidson, Dyson, Apple and many more. Conversely, why do so many potentially great innovations stay at the idea stage or flop when entering the market? Many examples such as DeLorean and Google Glass made the headlines. Many didn’t even get off the starting line.

During my career I worked almost exclusively in engineering-minded companies with deep engineering cultures. At Honeywell, we built and maintained very complex avionics and other aircraft components. At Kennametal, we helped customers build parts for aircraft, cars, pumps, or anything that needs to be machined.

As a business development leader, in charge of strategies for these large companies, I had many interactions with our internal engineering teams and often met with “would be entrepreneurs.” I listened to countless speeches and presentations from inventors that wanted their widget or technology to be included in our portfolio.

Some succeeded but many failed at the monumental task of demonstrating and eventually generating true economic value from an idea. The reality is that if we’re not failing, we’re not being ambitious or trying hard enough. The real question: What is the right approach?

OBSERVATIONS

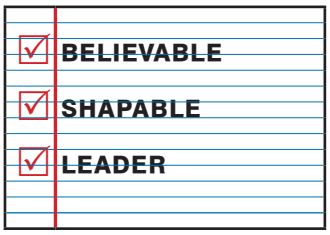
I learned the hard way that ideas and businesses succeed when three basic conditions are met:

1. Would anyone buy this widget or technology?
2. Can we make money at the price the customers are willing to pay for it?
3. Is the business model sustainable and not prone to disruption?

I can remember my first meeting with a divisional president, feeling very confident about our idea and solution. The business plan was engineered to perfection. Lots of data on #1 and #2 above. However, we were too casual on #3 and were politely sent back home to redraft. Lesson learned.

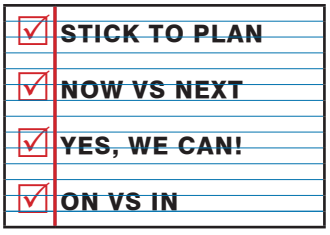
For any idea or business to succeed at those three basic conditions of success, you first have to attract investors. Over the years I became a big fan of Simon Sinek’s “Start with Why” philosophy. The basic idea is that “people don’t buy what you do, but why you do it”.

Think about it for a second. Would you buy from some boring idea, company or person? Why are we so attracted to big ideas and the people behind them? As an aerospace veteran and private pilot, I can relate to the Wright brothers and their “why.” More recently, I was invited as a supplier to Elon Musk’s SpaceX and, trust me, I got the “why” very quickly.



Well, as an entrepreneur, you're all of it: you are the idea, the business, the product or the solution in one package. This is when it all started to make sense to me. Those that succeeded in selling their ideas to us or to another investor had a common approach to warming our hearts and eventually opening our checkbooks.

1. They fundamentally "**believed**" that their idea/solution is the answer to a bigger why. They tested, tried again, redrew it many times until they were convinced this was the right fit. You could feel the perseverance, sweat and passion they had for their art. They didn't quit. The good ones were humble while being convincing. They answered all of our questions without us asking any questions directly. Would anyone care? Would anyone pay for it? Can we make money? Can we sustain it? We could feel success in the room. Conversely, I saw arrogance and "about me" too often. That didn't go so well.
2. They **listened** and took feedback well. I recall an inventor with a potentially disruptive approach to drilling composite stacks in aircraft assemblies. We had really constructive meetings with them during the ideation and prototyping stages. Over time, we invited aircraft manufacturers to the join the conversations. It all felt natural. Conversely, if one's "way is the highway" and no flexibility, the road will be much shorter.
3. Know when to talk about the why, the what, and the how. In those early stages, it is super critical to **pace yourself**. We want to talk too much about "it", explain how "it" works, and what "it's" made of down to the atomic level. We know our stuff, right? Well, the others may or may not care. It's really hard to play right all the time. Some in the audience are captivated, others, unfortunately, are falling asleep or start looking at their emails. Try to read who is the decision maker and adjust from there. I recall one presentation from a potential technology partner. I truly enjoyed the presenter's style, the detailed conversation and the potential fit with one of our business needs. I asked many questions to drill down further. But my boss, who was with me at that meeting, was lost after the third slide. He was the ultimate decision maker and told me after the meeting to not continue with them. He obviously had a very different opinion on how the meeting went. It took some effort on my part to re-establish that connection.



Now, let's pretend you have succeeded in getting funding and your business is starting up. The next question is how do we successfully pivot from idea to business? Here are some further observations contrasting those that made it versus the not-so-lucky ones:

1. **Stick to the plan:** They have a sturdy business plan and follow it. Remember: butterflies don't live long. That same innovator with that great idea on how to drill stacks of composites had new investors coming in. They decided to change the plan. It took three years to recover and we lost interest. There's a caveat to that: In one of our own disruptive plays, we thought the minimum viable product was to be ABC and about six months from planned launch, we discovered that the beta users wanted XYZ. Don't be too strict on the plan and when the evidence is solid, make the change. We did.

> "The reality is that if we're not failing, we're not being ambitious or trying hard enough. The real question: What is the right approach?"

2. **Sell what we have**: They don't talk much about what can be done in sales calls. They know they have to sell what they have NOW. Customers are like consumers. They want the greatest possible and sometime will wait until they can have that wonderful idea. That's another 60-90 days lost on that precious cash flow.
3. **Aim at "yes, we can"**: That's really hard for some of us, I know. When presented with a real challenge, don't be stuck in "why we can't" or over-engineer the thing in your head or, worse yet, during a client meeting. Take notes, say you'll think about it and that you already have some ideas. Go do something else and sleep on it for a few hours, which works for me.
4. **Focus on your business vs. In your business**: This is a classic failure mode. The ones that succeed find a little bit of time to think strategically ON their business versus running crazy about fixing all that can be wrong IN the business. For example, on a disruptive project that took years to materialize and fund, the team spiraled into daily activities that, over time, took us away from the big picture. Top management changes and lack of direction made us wander and lose our edge. Have the courage to step out of the chaos and think about what needs to be done strategically to fix the problem versus tactically applying a Band-Aid.

CLOSING REMARKS

Don't Quit and Persevere! If entrepreneurship is the right path for an idea, here are some practical steps one can

take to maximize chances of success:

1. Find or hire a business mentor from day one, someone that has done it, someone you can trust.
2. Develop your executive presence (writing, speaking and appearance) and leadership skills
3. Learn the lingo of business. Take a short course on marketing, finance and organizational design. No need to be an expert. This will give that warm feeling to investors that you can be a CEO with the right support structure.

I'll be looking forward to hearing about how your idea has shaken up an industry.

About Francois Gau

Francois Gau has a passion, curiosity and domain expertise in Aerospace, Manufacturing and Industrial Internet of Things (IIoT / Industry 4.0). As Vice President of Strategic Marketing & NBD with Kennametal, Francois lead the transformation of Kennametal in digital manufacturing that resulted in an IIoT platform used by tens of thousands of customers globally, every day. At Kennametal, Francois was also responsible for developing and implementing strategies in the Aerospace and Power Generation industries through product innovation, marketing, sales, and operations leadership. Prior to Kennametal, Francois held numerous positions with Honeywell Aerospace in Toulouse, France, and Phoenix.

He is now a Pittsburgh-based partner with velocityHUB, a training, consulting, executive coaching and leadership company. He advises some of the largest companies in the aerospace, automotive and manufacturing industries.

Francois holds a Master's in Business Administration from the University of Phoenix and a Bachelor's degree in Business Administration from the Institut de Formation a la Gestion of Toulouse, France. He was also a student of mathematics and physics at University Paul Sabatier in Toulouse. He is the recipient of many prestigious awards and holds a U.S. patent.

About velocityHUB

At velocityHUB Pittsburgh, our belief is that Growth can be Engineered through an actionable strategy that is executed through people development and targeted marketing/PR. Our methodology is proven, simple and actionable. We partner with clients to deliver:

- *Growth Strategy through High Performance Consulting,*
- *Training & Coaching of leaders by leaders at an affordable cost,*
- *Sales/Marketing/PR expertise*

Our vision is to build One Million Leaders to Engineer Growth. More at attaindre.velocityhub.com

PE

HUMAN ENGINEERING RESEARCH LABORATORIES

A UNIQUE ENTREPRENEUR ORGANIZATION SERVING BOTH INDUSTRY AND SOCIETY

By: Rory A. Cooper, Ph.D., Michael Lain, and Randall Williams, MBA

Overview

The Human Engineering Research Laboratories (HERL) is noted for its high level of technical expertise and collaborations with providers, researchers, and manufacturers of assistive technology. HERL is represents a unique entrepreneurial organization; supporting both deployment of products and services, and social entrepreneurship. Located in Bakery Square, a technology park in Pittsburgh, PA, HERL is a partnerships of the US Department of Veterans Affairs, the University of Pittsburgh, and the UPMC Health System, with support through grant and contracts from the National Science Foundation; Paralyzed Veterans of America; the U.S. Department of Veterans Affairs Office of Research and Development; the National Institute on Disability, Independent Living, and Rehabilitation Research; and many other organizations. Rory A. Cooper, Ph.D. is the Director and CEO, and Brad Dicianno, M.D. is the Medical Director and COO. HERL has more than 60 faculty, staff, and students working in Rehabilitation Science, Bioengineering, Physical Therapy, Occupational Therapy, Rehabilitation Counseling, Physical Medicine and Rehabilitation, and other fields.

Mission, Vision, and History

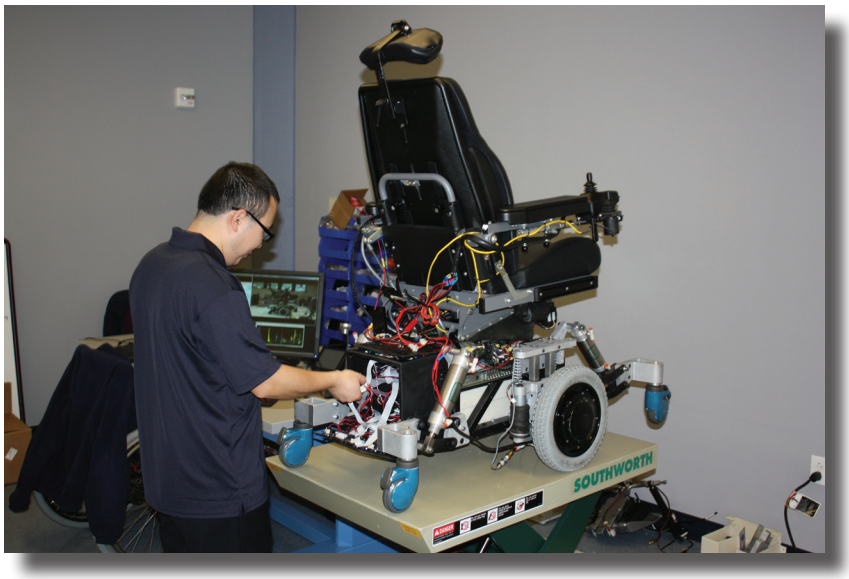
HERL was founded in 1994 by Dr. Cooper, who shortly thereafter was joined by Dr. Michael Boninger, and they quickly made names for themselves with their research, invention, and clinical contributions. Dr. Cooper is himself a Veteran with disabilities, and his vision of unencumbered mobility for all people with disabilities guides the privileged work that we do within HERL every day. HERL's mission is to continuously improve the mobility and function of people with disabilities through advanced engineering in clinical research and medical rehabilitation, and HERL's grand vision is to create a world where all people with disabilities have unencumbered mobility and function, so they can fully participate in and contribute to society. It is no exaggeration to say that HERL research has greatly contributed to the improvement of the quality of life among people with disabilities.

The goals and objectives have evolved over time as the needs of people with disabilities have changed and as new technologies have emerged. Several goals have remained constant throughout the tenure of HERL: Participatory Action Design and Research engaging people with disabilities and the clinicians who work with them is at the core of all the we do; Engaging a range of professions the contribute the rehabilitation practice and science working as integrated teams; Providing core resources to support talented and dedicated people; Effective and pervasive dissemination and knowledge translation; and Partnering with "best in class" organizations and people.

"HERL's mission is to continuously improve the mobility and function of people with disabilities through advanced engineering in clinical research and medical rehabilitation"

The initial focus of HERL was mostly on reducing secondary injuries due to long-term wheelchair use. Studies focused on reducing repetitive strain injuries, understanding mechanisms for pressure ulcer development, and power assist devices. Significant advances were made in these areas, and, for example, led to commercially available pushrim activated power assist devices, ergonomics pushrims on the market as the "Surge" and "NaturalFit", and the Consortium for Spinal Cord Injury Clinical Practice Guidelines for Upper Extremity Preservation. Our focus then changed to electric powered wheelchair controls and user interfaces; which led to improved control algorithms used numerous powered wheelchairs, novel joystick technologies including algorithms used on nearly all electric powered wheelchairs, and virtual reality assessments for training. The focus moved towards understanding the mechanisms of repetitive strain injuries as related to real-world activities (e.g., transfers, starts/stops, turns), and the initial work on robotics and virtual coaching systems. This led to widely used tools for ultrasound imaging, development of the Transfer Assessment Instrument, and the creation of the Virtual Seating Coach (now available from Permobil). Next the research and development focused on investigating smart and connected wearable devices, pneumatically powered mobility devices (licensed as the PneuChair), robotic mobility and manipulation (licensed to the local company RE2), and smart human-machine interfaces. To date, this has led to products such as the E-scale, Strong-Arm, Manual Wheelchair Vir-

tual Coach, Mobility Enhancement Robotic Wheelchair (MEBot) that competed in the inaugural Cybathlon, the PneuChair, and better understanding of factors affecting functional mobility and manipulation. These and other contributions are described below. Over time, HERL has adopted to the needs of people with disabilities and clinicians, to advances in technology, and scientific discoveries. All the while, HERL has continued to make ground-breaking contributions that have gained wider adoption and impact over time.



The first MEBot prototype being constructed, 2011.

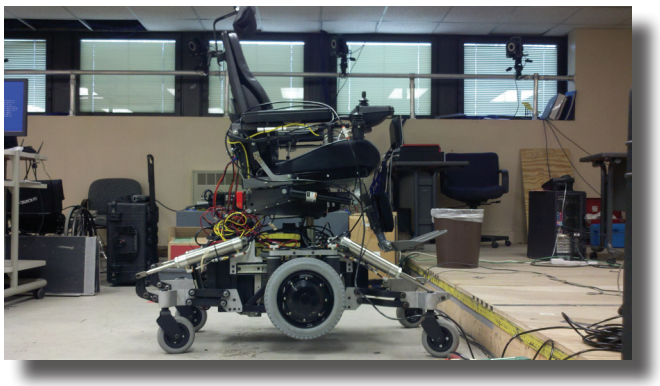
Global Impact

HERL has become internationally-recognized in advanced assistive robotics technology. One such technology, the Virtual Seating Coach (U.S. Patent Application #14/609,747), benefits power wheelchair users by using a smartphone app to control their power seating functions for the avoidance of sores and skin breakdown. Power wheelchair users are in their chairs for many hours at a stretch, which can lead to lesions like bedsores. To prevent this, power wheelchair users must use their power seating function to tilt themselves at specific angles for sufficient amounts of time. Virtual Seating Coach uses an app on users' smartphones to instructs them to on when and how to tilt, and then performs the prescribed tilt automatically if necessary. It is context-aware, so will not remind users if they are driving on a slope or in an unsuitable location. The app can be modified by a clinician to suit each user's individual needs. This technology has been licensed by Permobil and is incorporated into their complete line of power wheelchairs.

"HERL's creations have led directly to the invention of many improvements to the manual and electric wheelchairs used today by thousands"

HERL also become a leader in alternative power sources for mobility appliances with its PneuMobility work. The PneuMobility devices won the Kuzneski Design Cup for innovation in healthcare technology. The PneuChair and PneuScooter (U.S. Patent Application #62/274,556) are powered solely by compressed air, creating a technology that unlike traditional battery-powered devices is lightweight, less expensive, and able to become soaked without damage. It was created as an easy mobility solution for Veteran group housing, nursing homes, and even shopping centers, but HERL quickly realized the possibility of providing PneuChairs to other locations – specifically waterparks – when contacted by the developer of a new disability-inclusive waterpark in Texas. After the official unveiling, the PneuMobility project went viral on the web (it has currently received over 2 million views on the New York Times Facebook page), proving there is public interest in and a definite need for alternative powered-mobility devices. The PneuChair has been licensed by the SOAR Foundation to bring it to the marketplace, and is available to use by guests at Morgan's Inspiration Island.

HERL's creations have led directly to the invention of many improvements to the manual and electric wheelchairs used today by thousands. HERL researchers contributed to the development of Yamaha's pushrim-activated power-assist wheelchair (U.S. Patent #7,204,328), which provides manual wheelchair users extra power upon propulsion via small motors in the wheel hubs. Work on an isometric joystick and accompanying control algorithms (U.S. Patent #8,264,458) led to more efficient joysticks used in practically every electric powered wheelchair worldwide today. HERL also redesigned the casters and caster forks used in manual wheelchairs, inventing the Glide vibration-dampening caster fork marketed by TiLite (U.S. Patent #6,892,421) and the Pathlock caster system (U.S. Patent #8,490,242) from Accessible Designs, Inc. that allows easier travel on slopes or the use of ultra-light manual wheelchairs with one arm. Using the HERL-invented SmartWheel, available from OutFront, LLC, instrumented handrim among other tools, HERL researchers identified the most efficient wheelchair propulsion pattern which has led directly to a higher quality of life for manual wheelchair users, allowing them to preserve their upper limb functions much longer. This research has changed and improved clinical assessment and evidence-based practices for all wheelchair users. Chief among these breakthroughs were ergonomic wheelchair handrims molded to a shape more naturally fitting the human hand, marketed as the NaturalFit (U.S. patent #6,276,705) and the Surge (U.S Patent #7,497,456) both available from TiLite. To reduce the risk of injuries to caregivers, and to allow people to remain in their homes despite severe disabilities; HERL partnered with NextHealth to cre-



Finished first MEBot prototype, 2012.

ate a system that provides lift-free transfers from a person's wheelchair to bed. This has resulted in the AgileLife bed (U.S. Patent Application 15/883,908).

Local Impact

HERL has played a significant role in the development and progression of several local companies. ARTSCO was formed in 1996 by Dr. Mark Malagodi, a former faculty member in Pitt's Department of Rehabilitation Science and Technology (RST). Shortly after forming ARTSCO, Dr. Malagodi was joined by HERL alum Steven Garand in the role of VP of Engineering. ARTSCO works to close the gap between initial research projects and the marketplace and collaborated with RST to develop a tech transfer vehicle for application in the rehabilitation and assistive technology marketplace. In addition, ARTSCO has received support via two Small Business Innovation Research grants from the National Institutes of Health and the U.S. Department of Agriculture.

MEBot climbs a curb, 2015.

Pathway Access Solutions/pathVu, focuses on improving "walkability along sidewalks" for individuals of any ability. For nearly 20 years, pathVu has been dedicated to improving accessibility in public spaces. The key in this effort is PathMeT (US Patent Application 61/927,630), a surface profiler that measures sidewalk accessibility in accordance with U.S Access Board Standards. According to co-founder Eric Sinagra, a HERL alum, "a major part of pathVu is the PathMeT technology, a manually propelled device that characterizes sidewalk conditions, which was developed at HERL." Eric goes on to state that "the skills I personally learned while working at HERL have translated into skills I use everyday in running the business…pathVu strives to create a world that is accessible for all, and those efforts started at HERL. Additional HERL/pathVu team members include Dr. Jon Pearlman and Dr. Jon Duvall.

HERL enjoys a long history with RE2, a CMU spin-off that develops innovative technologies "that save lives and improve the quality of life." HERL Founder and Director, Dr. Rory Cooper, has worked with RE2 founder, Jorgen Pedersen, and Reeg Allen, on several initiatives, such as StrongArm (US Patent # 9,254,234), a patient assist robotic arm that aids in transfers, and more recently, the validation of a biomechanical exoskeleton simulator system developed by RE2.

Creating Entrepreneurs

HERL fosters interest, growth, and innovation in the Science, Engineering, Technology, and Mathematics (STEM) fields by working closely with the National Science Foundation (NSF) and the University of Pittsburgh. Each summer, HERL hosts students from colleges and universities across the country as part of the NSF-sponsored Research Experience for Undergraduates (REU) program. REU participants intern at HERL for 10 weeks in the summer and are fully immersed in an on-going HERL research or development project. Participants are exposed to the rigors of STEM fields and are required to produce a paper, a poster, and an elevator pitch based on their research experience. They gain valuable knowledge from their graduate student and faculty mentors and are better prepared for STEM graduate programs, as well as careers in STEM fields.

Through Pitt's First Gear program, students are given the opportunity to have their research or development project presented to potential funders. First Gear pairs researchers with business mentors who help them develop business and marketing plans with the goal of attracting additional/future funding that will help eventually bring their product to market. HERL has been exceptionally fortunate to have several student projects receive first place awards and funding.

Social Entrepreneurs

The nature of HERL's work with people with disabilities provides an opportunity for individuals who, more than creating a device or product, are interested in creating social change. In the United States and worldwide, people with disabilities have historically been ignored, passed over, discounted, and left out of full participation in their communities. Therefore, HERL is dedicated to righting this social wrong by creating leaders who, through their efforts and programs, are spearheading the ongoing struggle for full inclusion of all people with disabilities.

Programs for Veterans

As a Veteran with disabilities, HERL founder and director Dr. Rory Cooper is especially aware of the roadblocks that Veterans with disabilities encounter to full inclusion in society. Veterans who have just separated from their service are particularly vulnerable. To assist, HERL created programs specifically targeting this population: Experiential Learning for Veterans in Assistive Technology and Engineering (ELeVATE) and Advancing Inclusive Manufacturing (AIM).

MEBot competing at the Cybathlon, Zurich, 2016.

EL-

eVATE is a program designed for Veterans interested attending college for the STEM fields. Participants complete a ten-week paid research experience, complete a team project, learn 21st century skills in workshops, and prepare to begin/resume classes at a college of choice. ELeVATE participants work closely with vocational coordinators to ensure that adequate supports are in place for their academic success. During this time, ELeVATE students are offered housing and other family assistance. Following the 10-week research experience, the participants apply to accredited college programs. Upon acceptance, ELeVATE students stay connected to their cohort through study groups and other support groups and are encouraged to remain connected to the program by serving as mentors to new ELeVATE participants.

> *"The primary objective of the AIM program is to aid in the transition of rehabilitating Service Members and Veterans with disabilities to potential careers in advanced manufacturing"*

The primary objective of the AIM program is to aid in the transition of rehabilitating Service Members and Veterans with disabilities to potential careers in advanced manufacturing. AIM is an introductory vocational training program; AIM students learn how to design, develop, and evaluate their own product using established design principles. Over a 12-week period, AIM students learn the basic machining principles and practices as they cycle through the fundamental areas of fabrication, including carpentry, welding, prototyping, electronics, etc. As participants progress through the program, they obtain a general understanding of how the systems are designed and integrated. Upon completion of the program, AIM students can independently design, develop, and evaluate their own product (prototype) using established design principles. AIM has recently been opened to all people with disabilities, not just Service Members and Veterans.

Students for Disability Advocacy

HERL has consistently encouraged its students and staff to participate in advocacy for and awareness of people with disabilities. The University of Pittsburgh's Students for Disability Advocacy (SDA) was founded by HERL student Jonathan Duvall. The current SDA president, Brandon Daveler, is also a HERL student researcher. SDA is an advocacy and support group for University of Pittsburgh students with or without a disability. SDA advocates for more diversity, inclusion, and accessibility for all students, in academic, clinical, community, social, and research settings. SDA seeks to promote an intergenerational community among incoming students, current students and alumni with disabilities. The group is designed to create an optimal venue to exchange knowledge and wisdom while fostering academic and social interaction among its members. SDA serves the University of Pittsburgh by promoting an inclusive and diverse community of scholars: https://sites.google.com/view/pitt-sda/home

MEBot current prototype, standing, 2017.

International Society for Wheelchair Professionals

HERL is also home to the International Society of Wheelchair Professionals (ISWP). Founded in 2015 by Drs. Cooper, Jonathan Pearlman and Mary Goldberg, ISWP's mission is to serve as a global resource for wheelchair service standards and provision through advocacy, education, standards, evidence-based practice, innovation and a platform for information exchange. ISWP's vision is that all people who need wheeled mobility devices receive the appropriate products and services with dignity. Globally – and especially in less-resourced environments – most people who need wheelchairs lack access to both the wheelchairs themselves and the services needed to maintain them. ISWP promotes training and research activities, improving wheelchair design and manufacturing, and coordinating services via the World Health Organization Guidelines on providing manual wheelchairs in less-resourced settings. ISWP is comprised of and Advisory Board and several Working Groups, all of which are composed of assistive technology-focused professionals from around the world, including wheelchair clinicians, research scientists, humanitarian organizations, and manufacturers.

SWP ENTREPRENEURS

Advantus Engineers, LLC is a consulting engineering firm specializing in building commissioning, design, QA/QC, construction and project management, and environmental services.

What markets does your business serve?
Advantus serves commercial, industrial, institutional, and governmental markets.

How old is your business?
We have been in business for thirteen years.

How many employees?
We have ten employees.

What were the biggest hurdles at start up? later?
Initially, one of the biggest hurdles starting from scratch was not having a business work history. As Advantus has grown one of the challenges is balancing the ebbs and flows of the industry and our workload while maintaining a highly qualified workforce. When you are a small business and provide the services that we do for our clients, each employee is a trusted partner.

What have been the greatest rewards?
I think Advantus has succeeded because we truly respect our clients and have earned their respect, resulting in long-term relationships. We are proud to have been a part of many great projects and work for some outstanding clients and agencies.

What advice would you give someone contemplating starting a similar business now?
Have patience. It all takes time.

Have you ever needed to vet the question of acquisition? What weighed into your decision to continue as the owner?
No, being the owner, while challenging, is also extrememly satisfying.

SWP ENTREPRENEURS

All-Tek Staffing is a Civil Mechanical & Electrical Engineering & Staffing & Placement supporting Manufacturing and Construction in a 75 mile radius of Pittsburgh.

What markets does your business serve?
Heavy & Light Industrial, Oil & Gas, Industrial & Commercial Construction.

How old is your business?
16 years old.

How many employees?
15

What were the biggest hurdles at start up? later?
A lingering recession that gave us the opportunity to seize and develop market share that others had abandoned in. Survival is the strongest instinct.

What have been the greatest rewards?
The ability to gain market share and make a difference in the market, and with the clients, that we choose to service.

Mike Sylvester / All-Tek Staffing

What advice would you give someone contemplating starting a similar business now?
Know the difference between Frustration and Discouragement. Being frustrated is normal-it means that you know that you are capable and things are just not going your way. Keep working-it's your only chance that you'll have success. Being discouraged means that you've told yourself that you are not capable of success-you would not have taken this risk if you truly believed that you weren't capable!

Have you ever needed to vet the question of acquisition? What weighed into your decision to continue as the owner?
We get offers all the time. The reality is that the ownership group loves what they do and aren't ready to even consider an offer for purchase.

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