STEMulating: An Integrated Approach to Cultivating Our Future

Elizabeth Biddle, Ph.D., CMSP
CFSEC
Orlando, FL
elizabethbiddle7@gmail.com

Carol Ann Dykes
UCF Business Incubator
Orlando, FL
CarolAnn.Dykes@ucf.edu

Shawn Harrs, Ph.D.
Universal Orlando Resort
Orlando, FL
Shawn.Harrs@universalorlando.com

Robert Seltzer
NAWCTSD
Orlando, FL
robert.seltzer@navy.com

Abdul Siddiqui
PEO STRI
Orlando, FL
abdul.m.siddiqui.civ@mail.mil

ABSTRACT

For over 50 years, the need to increase the number of students who pursue STEM (science, technology, engineering and math) has been acknowledged. Yet the US continues to fall behind in student performance in STEM fields and pursuit of STEM degrees (US Bureau of Labor Statistics, 2009; Galloway, 2008; Rothwell, 2014; National Research Council Committee on Science, Engineering Education Reform, 2006;). The STEM talent pool impacts not only the industries that drive the US economy but also those that comprise the US defense industrial base. Now more than ever, STEM underpins the Department of Defense's (DoD's) ability to defend the Nation. While there are many factors that impact STEM education, a key element of increasing the STEM workforce is stronger local and regional partnerships among industry, academia, government, and nonprofits (Achieve, 2010). The Central Florida STEM Education Council (CFSEC) is a model of such a regional partnership with a long term objective of encouraging and preparing pre-college students to enter STEM fields of study and to pursue employment in the Central Florida workforce. The CFSEC targets primarily three audiences– parents, students and teachers – through communications and events. The CFSEC's goals are to 1) advocate for and raise awareness of the importance of STEM, 2) connect individuals and organizations with resources and each other, and 3) coordinate activities and partnerships that increase the awareness and availability of STEM education opportunities. This paper will provide an overview of the future outlook for the STEM workforce that highlights the compelling need for STEM initiatives to address the projected shortages (Bayer Corporation, 2014; Morones, 2013). The paper will describe the vision and governing model of the CFSEC and how it can serve as a model that other regions and states can adopt and tailor to implement a collaborative STEM community. Finally, the paper will conclude with the challenges encountered in establishing a CFSEC-like organization as well as best practices and lessons learned.

ABOUT THE AUTHORS

Elizabeth Biddle, Ph.D. is senior scientist with 15 years in the training and human performance research and development industry. She currently serves on the Board of Directors for the Central Florida STEM Education Council and the Women in Defense Central Florida Chapter. She holds a Bachelor of Arts in Psychology (Florida State University), Master of Science in Human Development and Counseling (Troy State University), and a Doctorate of Philosophy in Industrial Engineering and Management Systems (University of Central Florida).

Carol Ann Dykes manages the University of Central Florida Business Incubator @ the Central Florida Research Park. She was previously Associate Director of the Southern Technology Applications Center at the University of Florida and Vice President for Information Services at Technology Strategic Planning Inc. She holds a Bachelor of Science in Biology (University of Arkansas) and a Master of Library Science (Louisiana State University). She serves as Chair of the Board of Directors of the Central Florida STEM Education Council.

Shawn Harrs, Ph.D. is Senior Director, Marketing Technology, at Universal Orlando Resort. Previously Dr. Harrs was with the Walt Disney Company as Director, Customer Information Management Operations. He is an adjunct faculty member in the Graduate School of Computer and Information Sciences at Nova Southeastern University. He holds a Bachelor of Science in Computer Engineering (University of Central Florida), a Master of Business Administration (University of Phoenix) and a Doctorate of Philosophy in Information Systems (Nova Southeastern University). Dr. Harrs serves as Vice Chair of the Central Florida STEM Education Council.

Mr. Robert Seltzer currently serves as the Deputy Director of the Research and Technology Program Office and as the Command's STEM Outreach Coordinator (since 2009). Mr. Seltzer has worked for the Naval Air Warfare Center for 32 years as an aerospace engineer and research program manager and holds a Bachelor of Science in Aerospace Engineering (Polytechnic Institute of NY) and Master of Science in Aerospace Engineering (Purdue University) and Engineering Management (National Technology University). He serves as NAWCTSD's liaison to the Central Florida STEM Education Council.

Abdul M. Siddiqui currently serves as the resident subject matter expert in software architecture development for systems and product lines at US Army Program Executive Office for Simulation, Training and Instrumentation (PEO STRI). He is the Engineering Mentor and STEM Coordinator for PEO STRI and serves as the liaison to the Central Florida STEM Education Council. Mr. Siddiqui received his Master of Science in Software Engineering at the Naval Postgraduate School, CA.

STEMulating: An Integrated Approach to Cultivating Our Future

Elizabeth Biddle, Ph.D., CMSP
CFSEC
Orlando, FL
elizabethbiddle7@gmail.com

Carol Ann Dykes
UCF Business Incubator
Orlando, FL
CarolAnn.Dykes@ucf.edu

Shawn Harrs, Ph.D.
Universal Orlando Resort
Orlando, FL
Shawn.Harrs@universalorlando.com

Robert Seltzer
NAWCTSD
Orlando, FL
robert.seltzer@navy.mil

Abdul Siddiqui
PEO STRI
Orlando, FL
abdul.m.siddiqui.civ@mail.mil

INTRODUCTION

Science, technology, engineering, and mathematics (STEM) has become so important in recent years due to the 21st-century advances in technology that make technical knowledge a requisite for many different types of work. High-tech companies obviously need workers with STEM backgrounds, such as Ph.D.s in engineering and computer science. STEM workers are also vital to many manufacturers, whose automated, computerized and robotic systems require much more technical savviness than before (Fehrenbach, 2014). For example, modern-day machinists often need to know how to write computer code to program the machines they use. Advanced welding, too, with its complex mix of metallurgy, science, math and traditional know-how, has also become a STEM job.

American companies are reporting a lack of qualified candidates to fill a growing number of jobs in the STEM fields (Bayer Corporation, 2014). About 60 percent of job openings require basic science, technology, engineering, and math literacy, and 42 percent require advanced STEM skills, according to a new survey of 126 chief executive officers (Morones, 2013). However, the number of students who choose STEM fields continues to decline or, at best, increase at a rate too low to fill the growing number of jobs (US Bureau of Labor Statistics, 2009; Galloway, 2008; National Research Council Committee on Science, Engineering Education Reform, 2006). Continued failure to prioritize development of STEM-educated graduates will contribute to a decline in economic growth, national security, and the U.S. standard of living, as well as decrease the prominence of the U.S. education system (NSF, 2010; Spellings, 2006).

Lack or loss of interest or confidence at the early stages of education creates a skill shortage seen at later stages when students make their career decisions and enter the job market (Fleischman, Hopstock, Pelczar, & Shelley, 2010). The measurements of performance in mathematics and science literacy continue to show that 15 year old students in the U.S. display trends at or below the average of Organization for Economic Cooperation and Development (OECD) countries on the literacy scale (Fleischman et al., 2010). Educational institutions at every level must continue to innovate so that students obtain the education and skills required to realize the benefits of a college degree (Spellings, 2006). The ability to help students smoothly transition into the technical and professional careers of tomorrow is linked to the ability to create "a system that embraces the great majority of our students and prepares them to become productive members of what could be—but certainly is not now— the most capable front-line work force in the world" (Marshall & Tucker, p. 208).

Partnerships between for-profit and non-profit organizations focused on STEM education across the United States are becoming a key component in closing the STEM education gap. Such mutually beneficial partnerships between academia and industry can create avenues for educational institutions to meet the needs of industry leaders (Nazzal & Hillsman, 2010). Nazzal and Hillsman also contend that collaboration permits industry to research potential emerging areas of learning and development and serves to increase the visibility of academia to industry. As the industrial landscape continues to evolve, educational needs are likely to evolve with it (Felix & Pope, 2010).

In 2008, STEM leaders in academia and the simulation and training industry in the East Central Florida region around Orlando, Florida, recognized the fragmented nature of STEM education activities across the region and began discussions that lead to the formation of just such a collaboration. Those industry, government and academic

leaders were frustrated by discovering they were duplicating efforts, pursuing the same resources, and not impacting many areas of the community because of the lack of ability to coordinate efforts. There were a number of top level initiatives that engaged the education system and business leaders. Yet there was a lack of awareness across the general community about STEM education and the career paths it opened up. They recognized the importance of having a multi-faceted, grassroots community organization that could facilitate communication and coordination among the many players so greater impact could be achieved. They also recognized the need for a "united message" about STEM in the community to improve advocacy for more organizations to engage and support STEM activities. The resulting organization, the Central Florida STEM Education Council (CFSEC), was officially launched in 2010 with a focus on six counties in East Central Florida (Orange, Osceola, Seminole, Brevard, Volusia and Lake).

Those leaders developed an organization and approach to bring industry, government, academic and nonprofit organizations together to provide support to three key audiences (parents, students and educators) that contribute to the success of STEM education. The remainder of this paper will describe the structure, approach, guiding philosophies, goals and objectives used to create the CFSEC organization, which is proposed as an approach to be used in other regions to support STEM education and career development. Additionally, the paper will use CFSEC as an example providing its current status in achieving these goals, challenges faced and recommendations for adopting this approach in other regions.

THREE-PRONGED APPROACH TO SUPPORTING STEM

Overview

When a small group of determined leaders from the military simulation and training community in Central Florida decided to spearhead the development of the organization, the first goal was to identify a) what STEM initiatives and programs were needed, b) what was already in the community and c) what was missing. Dialogue with a wide range of individuals and organizations took place for two years to identify which STEM education initiatives were in place, who was involved and where the gaps were. In addition to the general lack of awareness of existing STEM education programs, also missing were three other essential elements of successful STEM education – 1) awareness of informal learning activities outside the classroom, 2) educator understanding of the real world applications of STEM skills and 3) parents' understanding of STEM and the potential it offers for high paying career opportunities.

The organization's model is based on three key areas of activity to address the identified gaps in STEM education support in the community:

1) ***Advocate*** – Build a grassroots, multifaceted community engaged in supporting STEM education
2) ***Communicate*** – Increase visibility of STEM programs, resources, needs and importance
3) ***Coordinate*** - Facilitate collaboration between existing STEM programs and support the development of new programs

The CFSEC recognized that, to be effective, the STEM community-building efforts needed to be wrapped around the three key influencers of a student's career path: Parent, Educator and Community (Figure 1). Using CFSEC as the representation of the Community, activities are directed at the inner layers: Student, Parent and Educator.

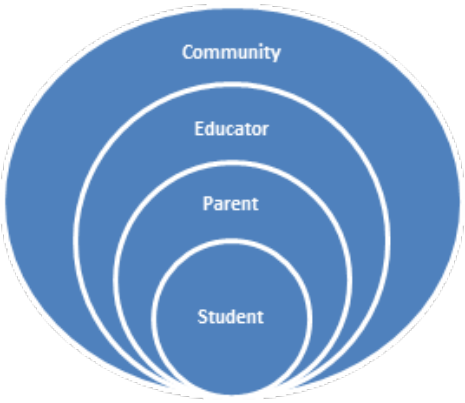

Figure 1: Effective STEM support is multi-layered

1) ***Students*** – Better understand their needs and increase their exposure to the relevance of STEM and new learning opportunities.
2) ***Parents*** – Increase their understanding of STEM, the importance of it for their children's future and resources available to support their children's interest in STEM.
3) ***Educators*** – Increase their understanding of the real world applications of and opportunities in STEM and ways to share that with their students.

The following subsections provide more details regarding the organization's formation, structure and activities.

Forming the Organization

Prior to 2008, key individuals and organizations across the Central Florida community were concerned about STEM education and engaged in activities and programs to support it. They operated, to a large degree, in isolation from each other. Yet, they were targeting the same key audiences – students and educators. As awareness of the importance of STEM increased in general, several of those individuals found themselves literally "bumping into each other in the school hallways". It became increasingly apparent that there was a growing focus on STEM education but very little awareness or coordination across the multitude of organizations involved. This uncoordinated approach created difficulties for the schools because of the time consuming efforts to find and separately engage with each of the various organizations. It also created a fragmentation of time and resources that lessened the potential impact of the STEM education efforts in general.

Those individuals began a dialogue about creating an organization that would serve as a hub to help them connect with each other and work together. Soon, additional organizations emerged to contribute to this effort. Regular meetings began in 2008 to begin to develop the organization. In the first two years, those meetings were focused on several key goals and activities described below.

1) ***Engage with and understand the school system activities and needs*** – Representatives from the target school districts were invited to present to the group and share what they were doing, what was working, who they were working with and what they needed help with.
2) ***Engage with and understand who was already involved in STEM education efforts*** – Representatives of a variety of organizations offering STEM programs in the community were involved to participate and present their programs to the group.
3) ***Assess what was missing*** – In addition to the organizations mentioned in items 1 and 2, organizations who were not identified as supporting a STEM program, but vital to the community (e.g., chamber of commerce, economic development commission, education professionals at various universities and community colleges) were asked to offer their perspective.
4) ***Determine what the focus of a new organization should be*** – Those early discussions confirmed there was a growing need for an entity that would "bring all the STEM efforts together" to connect and partner as well as provide a source of information about programs and organizations across the community. It became apparent that a critical missing element in all the existing efforts was engagement of parents, who are critical influencers on their children's education and career choices. It also became obvious there was a need for an organization easily accessible to individual teachers and to smaller organizations in the community interested in participating in STEM education efforts. Most of the existing organizations required significant funding commitments to participate and operated at a higher executive level such as corporate presidents and school superintendents.
5) ***Develop a well thought out, solid organizational structure with critical governing elements in place*** – In order to become a legitimate organization, professional legal and financial assistance was sought to support the development of foundational documents, policies and procedures. Examples of these elements include By-laws, Articles of Incorporation, a Board of Directors policy, an accounting system, financial policies, a bank account, and membership documents. Additionally, an application for 501(c)3 status was filed with the state and US Internal Revenue Service to enable the organization to operate as a legal non-profit organization.
6) ***Put marketing/outreach basics in place*** – A brochure, website, logo and organization business cards were developed through volunteer support of the organization's members. All of those items have been redone several times as the organization has developed and gained a better understanding of what works and what is needed. A merchant services agreement for credit card processing was established to provide an easier means of payment of membership dues and donations after issues in only receiving cash or checks became apparent.

Organization Structure

The Board of Directors (BOD, Figure 2) is comprised of industry, academic and key nonprofit organizations, provides the overall leadership of the organization and is supplemented by Board Advisors representing government

organizations. (For the remainder of the paper, BOD refers to the BOD industry and academic members as well as the Board Advisors.) The BOD oversees seven committees that carry out the work of the organization. The majority of the work of a well-organized nonprofit is carried out by committees that have clearly defined roles and areas of responsibility as well as dedicated leadership. As such, committees were defined and formed around four key areas of need to carry out the three areas of activity – Advocate, Communicate, Coordinate – and to address the three target sectors – Students, Parents, Educators. Each committee is responsible for a specific area of activity but works closely with other committees to carry out their role. Each committee is also responsible for identifying challenges, opportunities and resources needed and presenting those to the BOD for discussion and decisions.

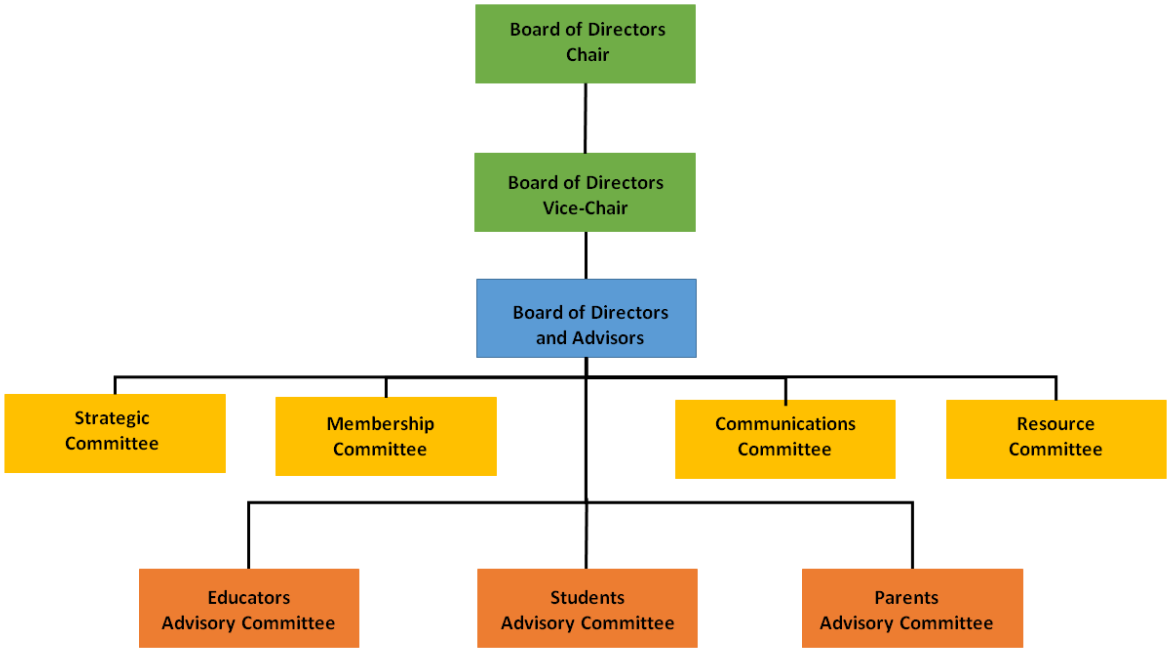

Figure 2. Organizational Structure

Board Committees

BOD officers and committee chairs form the Strategic Committee which has the responsibility for laying out the vision of the organization. The Strategic Committee is also responsible for leading long-term planning activities, developing recommendations to present to the BOD regarding regional growth or specific campaigns, addressing key organizational issues such as financials, partnership opportunities, resource allocation, and Board development. It is the Strategic Committee in particular that manages the organization's goal of Advocate to build a broad-based community around STEM in the target region.

The Membership Committee actively recruits new members and tracks the status of current members. The Committee is chaired by a member of the BOD but is comprised of BOD members as well as CFSEC general members. Specific duties include identifying and reaching out to individuals and companies that support STEM education and maintaining up-to-date membership records. Key industry sectors in the region were identified along with specific organizations in each category. Outreach to those organizations is focused on broadening the membership base of the organization as well as continuing to identify existing STEM activities in the community. The Membership Committee plays a key role in accomplishing the Advocate goal as well as the Coordinate goal by having individuals who are familiar with all members of the organization and serve as points of contact for inquiries.

The Communications Committee ensures that information about STEM activities, organizations and opportunities as well as CFSEC activities is distributed to all members and the broader community in a timely fashion. The Committee is chaired by a member of the BOD, but is comprised of BOD members as well as CFSEC general members. Specific responsibilities include: developing and disseminating STEM messages aimed at Educators, Parents, Students and the Business Community; developing and executing the plans for quarterly General Council

meetings; developing and publishing a monthly e-newsletter; coordinating outreach opportunities and maintaining a robust website to provide current news and resources for Students, Teachers and Parents.

A Resource Committee comprised of BOD members is tasked with leading the efforts to generate non-membership fee funding to implement the activities identified by the other committees to meet the goals of the organization. Sources include grant opportunities, sponsorships and donations. Securing funding to start and grow a new organization was not easy since the decision was made from the beginning to function as a grassroots, community-based organization.

Initially, funding was secured through solicitation of corporate donations, small corporate foundation grants (e.g., $5K) and membership dues. Extensive resources have been provided through volunteer time and in-kind donations from BOD member organizations of meeting space, staff support, printing of materials and other necessary resources to establish the organization. Relevant philanthropic and corporate foundations requests for proposals (RFPs) are regularly reviewed by the Resource Committee to identify funding opportunities. If one is found, the initial investigation is carried out by the Resource Committee then presented to the Strategic Committee for additional discussion and final determination on whether to pursue it or not.

Board Advisory Committees

Along with the formation of BOD Committees to drive the three areas of activity, it was recognized that Advisory Committees comprised of members of the three primary target sectors would be vital to ensure an accurate understanding of how to engage with each sector. Due to the required number of volunteers to support these committees, these committees were planned to come online as the organization membership grew.

The Educator Advisory Committee (EAC) was the first target sector advisory committee formed and is comprised of those individuals responsible for STEM activities in each of the counties the organization supports (e.g., the organizations region of reach). The EAC is led by BOD members and supported by the general membership. The key role of the EAC is to identify the Educators' needs and enable them to connect with Council members. This focus on the Educator is critical to ensure that they have the knowledge of tools and available support in order to develop their students in the STEM fields. In order to provide Educators with the support they need to develop future STEM professionals, the EAC supports a number of functions. A key one is Educator support by disseminating information about STEM programs within the participating school districts that need volunteers from the community. The EAC distributes information to the broader community about STEM programs being offered within respective schools such as magnet programs. The EAC coordinates the organization's participation in STEM nights and STEM days at local schools.

The Parents Advisory Committee (PAC) will be comprised of parents and BOD members. Parents play a major role in the educational development of their children. However, most parents are not educators by profession and they have few tools, little knowledge and lack confidence to nurture a passion for STEM in their children. The PAC will focus on providing parents with access to information and resources that can help supplement their child's education. It will also gather input from parents on what channels work best to provide information to them, what messaging about STEM is effective, and how their children perceive and engage in STEM.

The Students Advisory Committee (SAC) will be led by a BOD member with membership comprised of students and student focused STEM organizations. The focus of the SAC will be to provide students with information and resources aimed at STEM education and opportunities such as experiential learning opportunities and scholarships. Another goal of the SAC is to better understand what students perceive about STEM topics, what inspires them, what they struggle with and what they will respond to. Insight to these needs can be been gained through students attending and/or participating on the program at CFSEC General Council meetings.

EXAMPLES OF IMPLEMENTATION

The three-pronged approach to STEM organizational support described in the prior section was developed and implemented by the CFSEC. This section provides an overview of CFSEC's progress in meeting the goals described previously and provides examples of implementation. The section is organized around the three activities of Advocate, Communicate and Coordinate.

Advocate – Create Community

The CFSEC has positioned itself as a "grassroots" organization to both complement existing STEM organizations and initiatives and to reach and engage members of the target sectors on an individual basis. Top-level, public sector-led STEM initiatives existing in the community play a key role in bringing together public officials, government agencies and economic development organizations around STEM. But a holistic approach to STEM education and creation of a multi-layered community to engage and support students requires accessibility by organizations of all sizes and types as well as individual students, parents and educators (Figure 3).

Figure 3. Advocate – Create Community

One element of creating accessibility is membership fees. The CFSEC membership fees range from $40 - $200 and were intentionally established at a modest level to make it easy for organizations of any size and type (large corporations, small corporations, schools, nonprofits as well as individuals) to join the organization. While large organizations can generally afford larger membership fees, small companies, public and private schools/academic organizations, nonprofits, and individuals usually cannot.

A key activity that supports the Advocate goal as well as the Communicate and Coordinate goals is the CFSEC quarterly General Council meetings, which average 70-100 attendees. During the first few years, meetings were held twice a year and featured speakers representing a wide range of STEM programs in the region, as well as updates on CFSEC activities. That provided an environment for individuals from across the STEM community to learn about and connect with each other, as well as help create opportunities for the CFSEC to engage with potential members, partners and opportunities for outreach.

Starting in 2014, the meeting frequency was increased to four times a year in response to demand and the need to increase focus on the target sectors. In 2014, each meeting focused on one of the target sectors – Students, Parents, and Educators – and features topics and speakers relevant to that audience. For example, in February of 2014, the theme was Parents. Speakers included organizations that engage and equip parents to support their children in STEM.

In 2015, the themes are focused on key industry sectors in the region, the STEM skills needed and the career paths available with speakers and panels who can address that theme from multiple perspectives. The meetings are held in a venue that exemplifies the theme. For example, in February of 2015 the theme was "Playing Games: STEM and Game Development". The event was held at a graduate academy for gaming. The audience included corporate representatives, school administrators, individual teachers who brought students with them, local nonprofits, academia and parents.

The General Council meetings have tangibly supported the other two activity areas – Communicate and Coordinate – as will be discussed in following sections. They highlight how broad the STEM community is as evidenced by the diverse audience that attends each of the General meetings. The composite of attendees at the meeting focused on Parents was very different from that at the Game Development event. The diversity has been beneficial in that it has quickly broadened the visibility and impact of the CFSEC and confirmed that nearly every sector of the community is interested in STEM from some perspective. However, that same diversity has presented a challenge in fostering connectivity across different industry sectors. It is a challenge still being addressed.

The meetings drive membership. After every General Council meeting, several organizations or individuals join the organization as a result of experiencing the connectivity and sharing that takes place at the meetings. We have been gratified at the number of teachers that attend the meetings and sign up for individual memberships, which directly connects them to CFSEC members and resources. Smaller companies, as well small nonprofits, have found the meetings to be helpful ways to build visibility and support for their organizations, and to learn about resources and STEM professionals to call on for assistance.

Another method of advocating is securing funding through grants. The CFSEC has just submitted an application for a large grant ($40k) that will support, if awarded, project-based learning workshops for middle school STEM

teachers in four counties in coordination with two other STEM organizations. Additionally, a sponsorship package was developed and rolled-out a few months ago. One of the sponsor packages is offered in partnership with WUCF-TV, the local PBS station, and provides significant visibility for an organization through on-air messages throughout the year. PBS offers a growing number of STEM-focused programs for students as well as resources for educators and parents. This is an example of how the CFSEC continuously seeks ways to creatively collaborate with other organizations to secure resources as well as carry out activities.

Communicate – Share Information

Figure 4. Communicate – Share Information

The CFSEC is positioning itself as a "portal" for information and news on topics such as organizations offering STEM programs, opportunities to volunteer at STEM events, scholarship programs, resources for all three target sectors, and STEM education developments both locally and around the state (Figure 4). The primary channels for information distribution are the website (www.centralfloridastem.org) and a monthly newsletter. Initially periodic emails were sent out (using a Gmail account created for the CFSEC) about key STEM events in the community, calls for volunteers for events (e.g., at schools or in the community) or opportunities to get involved with the CFSEC. By 2013, a quarterly newsletter was being distributed to share information about STEM in the community, upcoming General Council meetings and updates on the CFSEC activities. Since October, 2014, the newsletter has been produced monthly. The newsletter – more than anything else – has helped create visibility for the CFSEC and for many STEM programs, resources and organizations in the community (Figure 5).

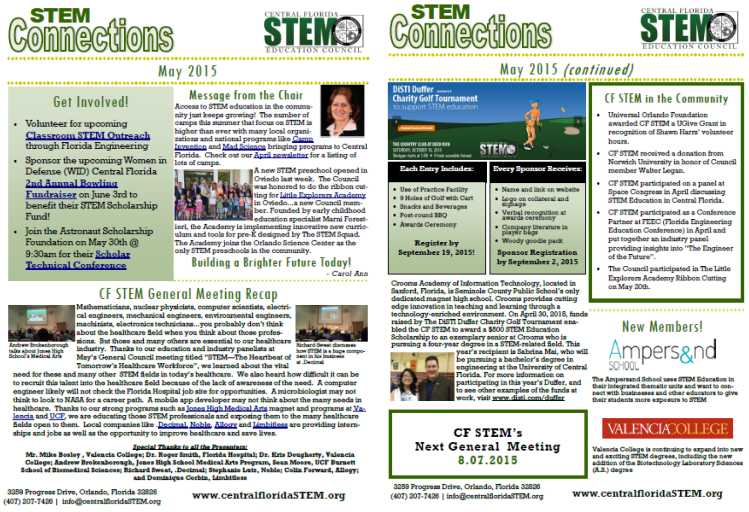

Figure 5. CFSEC Newsletter

Developing a website proved to be a bit challenging since the CFSEC did not have much money to spend on one. In addition, the initial versions of the website did not have the necessary functionality since we were still learning what was needed. By the time we had funds to pay for professional support, we had a much clearer idea of what we needed.

As distribution of the newsletter and awareness of the website have grown, so have calls for help from across the community…"Are there STEM focused elementary schools in my area?", "What STEM summer camps are available for my middle school daughter?", "Can you help us recruit volunteer judges for our science fair?" and more. Increasingly, we are also getting calls from around the country as various organizations look for connections in STEM in Central Florida. For example, recently the Keystone Science School in Colorado called asking for help. They asked for assistance in recruiting Florida teachers to participate in a fully-paid, one week institute aimed at developing knowledge and skills about environmental concerns and project-based learning teaching methods. Duke Energy is a sponsor of the institute, and Florida is one of their key service areas. The CFSEC was able to quickly distribute the information via email, website and the newsletter. A number of Florida teachers applied as a result.

Finally, Parent focus groups are being implemented across the CFSEC target region to gather information directly from parents and to identify parents who would like to participate in the PAC. This Board Advisory Committee is in the process of being implemented. Connections with a number of parents have already been established through the activities of the CFSEC. Outreach activities by the CFSEC also have provided parent connections. Examples of that are participation in STEM nights at local schools, exhibiting at the first ever STEM Pavilion at the Central

Florida Fair earlier this year, and attendance at local events run by other organizations such as Lego competitions. A number of individual CFSEC members are parents who are interested in being connected to the broader STEM community.

Coordinate – Foster Connections for Greater Impact

Figure 6. Coordinate – Foster Connections for Greater Impact

Coordination…connection…collaboration all result from Advocating and Communicating. It is where tangible results are most visible. When people and organizations are brought together for a common purpose, it benefits the target audience (Figure 6). This leads to the development of on-going relationships that have a positive impact on STEM initiatives. For example, the DiSTI Corporation attended some of the initial General Council meetings. They quickly realized that many of the organizations needed financial help to be able to impact more students. They decided to create the DISTI Duffer STEM Charity Golf Tournament and channel the resulting funds through the CFSEC to organizations they wanted to support. Last year DISTI Duffer proceeds supported the PEO STRI-NAWCTSD Navy SeaPerch Summer High School Internship Program, scholarships for YMCA Summer STEM camps, a scholarship at Croom's Academy in Sanford Florida and the I/ITSEC Teacher Workshop described below.

The EAC, the only one of the three Board Advisory Committees that has been fully implemented, has organized a Teacher Workshop offered the last few years during I/ITSEC. In 2014, 45 teachers from the six county region participated in a half-day workshop that lead them through a variety of project-based learning activities presented by organizations such as NASA and American Society for Civil Engineers. Those activities were specifically designed to be easy, affordable activities they could take back to the classroom. For the I/ITSEC teacher workshop, funding was allocated from the CFSEC budget, and additional funds were provided via sponsorships from several member organizations, to pay for project materials, lunch, and reimburse some of the schools for substitute teachers (without which some educators would not have been able to attend the workshop).

In addition to the Workshop, the CFSEC has participated in the I/ITSEC STEM Pavilion for the last five years and supported bringing other organizations into the exhibit area. Starting with the 2015 I/ITSEC event, the CFSEC has been asked to assume responsibility for managing the STEM Pavilion and will be able to bring an even wider range of relevant organizations to the exhibit floor.

In 2013, Wet n' Wild attended some of the Council meetings because of their interest in starting a STEM summer camp at their aquatic theme park. They knew they had a great facility to attract students and parents. However, they did not know how to develop a STEM curriculum. They asked for help and were connected to STEM curriculum specialists in the school system. In 2014, they initiated their STEM camp – AquaLab - with dozens of student participating in STEM activities and having fun while experiencing the real world applications of STEM.

The University of Central Florida initiated the Florida Engineering Education Conference a few years ago. For the last three years, the CFSEC has coordinated the industry panel at that conference, bringing together a diverse panel of industry leaders to share insights with the 100+ educators in attendance about the future needs of industry. That has resulted in connections between schools and those industry representatives for follow on engagement. It has also provided insight into the educator community as well as visibility and connections. For example, one of the educators in attendance at the 2015 FEEC is a partner with the CFSEC in a grant proposal recently submitted.

These are just a few examples of how the CFSEC has been able to facilitate coordination of interactions that are making an impact in STEM education.

RECOMMENDATIONS BASED ON LESSONS LEARNED

There have been many lessons learned during the formative and initial operational years of the CFSEC. Every organization is different. Every community is different. But based on our experience, we offer the following recommendations for establishing a grassroots, community-based STEM education organization:

1. Take the time to do your homework very thoroughly. If the first few years had not been spent dialoguing with a wide range of organizations and learning what existed and what did not, the organization's focus would not have been so clearly defined. It would be very difficult to articulate how the CFSEC differs from other organizations in the community. We might have ended up duplicating what already existed rather than complementing and supporting what was already in place.
2. It's not about credit; it's about community. Realize that existing organizations may feel threatened and see you as competition, but it is important to not react defensively. Be aware of their perspective, acknowledge their importance in the community, and offer to support them. If your organization has been well thought out, and is truly filling a gap in the community, that will become clear. Others will realize you are not the threat they perceived you to be.
3. Be very clear on who you are and who you serve. There is a need for different types of STEM organizations in a community. Some will operate at a higher public level. Some will focus on specific programs or audiences. There is a place and a role for each of them. For the CFSEC, the focus on parents and informal STEM learning opportunities along with the goal to collect and distribute information about ALL organizations engaged in STEM is a very clear difference that is easy to explain.
4. Remember that Board members are volunteers. They have full time jobs, can burn out and availability can change. Have more than one Board member centrally involved in any key activity so one is always available to participate. Always be identifying other individuals and organizations who can serve on the BOD in the future.
5. Pay attention because you will find information about STEM in your community in all sorts of places. A great deal of information about people and organizations engaged in STEM in the community has been gleaned from reading newsletters of local organizations, newspapers in the area, especially the smaller community papers since STEM activities are "bigger" news there. Local libraries and academic organizations and professional associations of all sorts are engaging in STEM. Set up Google alerts to pick up news. We have alerts set up for "STEM and central and Florida" and "STEM and Orlando".
6. Ask other organizations in the community what they need and support their agendas to the extent possible. The goal is not to drive "our agenda" but rather to be a link to connect the agendas of other organizations and weave a stronger network in the community.
7. Look for an "Insider Hero" when working with another organization. Find someone in the system who is passionate about what you are doing and willing to put in the effort to make things happen with a little guidance and support.
8. Recognize that educators are totally overwhelmed with all they have to do and have many limitations on their time and resources. Make it as easy as possible if you want them to participate.
9. Facilitate Project Based Learning as much as possible because it is the most effective way to reach all 3 groups – Educators, Students and Parents. Hands-on experience drives better understanding, makes something relevant and engages the mind. It empowers Parents and Educators with a greater sense of confidence about teaching STEM principals.
10. Recognize the "cumulative effect". STEM is a big problem and no one organization can do enough to solve it. Small and consistent participation (STEM nights, FIRST robotics, Science Fair Judging, Science Olympiad, Rocketry Club and Bridge Building etc.) of the CFSEC members in various STEM activities throughout the year accumulate to make a significant impact each year.
11. Collaboration efforts have to be short. They have to be started and implemented immediately within the school year to be successful. There is much Educator turn around each year and little continuity after summer breaks.
12. A grassroots STEM community is localized. The CFSEC supported the Space Coast Women in Defense in replicating the CFSEC model in Brevard County and continues to support them as an extension of the CFSEC.

CONCLUSION

The lack of students pursuing STEM related educational and career areas is evident, and the negative impact this will have on the nation's ability to thrive in the technological world that is evolving is apparent. This paper describes an approach for a region to come together as a community in an organized fashion to Advocate, Communicate and

Coordinate STEM related initiatives. This approach calls for a focus on three primary audiences: the Educator, the Parent and the Student.

The CFSEC was formed in 2010 after members of the Central Florida technology community recognized the lack of connectivity among various STEM programs in the community. The CFSEC founding members developed the three-pronged approach of Advocating, Communicating and Coordinating to ensure that Educators, Students and Parents have access to STEM related activities and resources. CFSEC's long term objective is preparing and encouraging pre-college students to enter technical fields of study and to pursue employment in the Central Florida high-tech workforce. The organizational approach described in this paper is useful in meeting these objectives and is offered as a model that can be replicated in various regions around the country.

REFERENCES

Achieve (June 2010). Strategies for Leverating STEM in Support of College and Career Reach Graduation Requirements. Retrieved from www.achieve.org/files/StrategiesforLeveragingSTEMinSupportofCollege-andCareer-ReadyGraduationRequirements.pdf.

Bayer Corporation. (2014, October). The Bayer Facts of Science Education XVI: US STEM Workforce Shortage—Myth or Reality? Fortune 1000 Talent Recruiters on the Debate. *Journal of Science Education and Technology*, *23*(5), 617-623.

Fehrenbach, P. (2014). STEM shortage is most acute for manufacturers. *Industry Week.* Retrieved from http://www.industryweek.com/stem-roots

Fleischman, H. L., Hopstock, P. J., Pelczar, M. P., & Shelley, B. E. (2010). *Highlights from PISA 2009: Performance of U.S. 15-year-old students in reading, mathematics, and science literacy in an international context*. National Center for Education Statistics, Institute of Education Sciences. Washington, DC: U.S. Department of Education. Retrieved from http://nces.ed.gov/pubs2011/2011004.pdf

Galloway, P. (2008). The 21st century engineer: A proposal for engineering education reform. Washington DC, USA: ASCE.

Henniksen, Ellen, Dillon, Justin, & Ryder, Jim (2014) *Understanding Student Participation and Choice in Science and Technology Education.* Springer, September 17, 2014

Marshall, R., & Tucker, M. (1992). *Thinking for a living: Education and the wealth of nations*. New York: Basic Books.

Miller, Jon (2010) Parents still major influence on child's decision to pursue science careers *Michigan State University*, February 21, 2010.

Morones, A. (2013). Science education. *Education Week*, *33*(10), 4. Retrieved from http://www.edweek.org/ew/articles/2013/10/30/10report-2.h33.html

National Research Council Committee on Science, Engineering and Public Policy (2006). Rising above the gathering storm: Energizing and employing America for a brighter economic future. Washington DC, National Academies Press.

National Science Foundation (NSF). (2010). *Preparing the next generation of STEM innovators: Identifying and developing our nation's human capital*. NSB-10-33. Retrieved from http://www.nsf.gov/nsb/publications/2010/nsb1033.pdf

Nazzal, D., & Hillsman, C. (2010). *Better together*. *Industrial Engineer: IE*, *42*(9), 26-30.

Rothwell, Jonathan (2014) Short on STEM talent. *U.S. News & World Report*. Retrieved from http://www.usnews.com/opinion/articles/2014/09/15/the-stem-worker-shortage-is-real.

Spellings, M. (2006). *A test of leadership: Charting the future of U.S. higher education*. A report of the Commission appointed by Secretary of Education Margaret Spellings U.S. Department of Education, Washington, D.C.

US Bureau of Labor Statistics (2009). Retrieved Sept. 2009, from http://www. bls.gov/.