

NYSID's Project CREATE: An Organizational Model for Service Learning through Assistive Technology Development

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Abstract — Project CREATE (Cultivating Resources for Employment with Assistive Technology) is an organization established by NYSID (New York State Industries for the Disabled, Inc.) in collaboration with member agencies such as Goodwill Industries of Greater New York & Northern New Jersey (GIGNY) and universities such as SUNY (State University of New York) Maritime College. Project CREATE sponsors capstone design projects where students develop assistive technology for customers at member agencies. Launch projects included the design of a modified “tagging gun” for use by sight-impaired employees for use in attaching price tags for clothing resale. The students had a successful design experience by meeting the customer’s challenging need for a 2x productivity improvement which enabled teams of sight-impaired people to now economically perform this task. The wider collaboration of Project CREATE also enables NYSID to advance its outreach mission. The structure of Project CREATE enabled all parties to succeed in a win-win-win fashion.

Index Terms— Assistive Technology, Engineering Education, Product Design.

I. INTRODUCTION

CAPSTONE design projects are an integral part of all CABET accredited undergraduate engineering programs [1]. External sponsorship of design projects has been applied with success in many venues. This may be enabled through multiple project organizations. One example is the SAE (Society of Automotive Engineers) Formula SAE® competition [2]. Another organizational model is for the students to develop a design for a person who acts as their customer. Industry or government sponsored capstone projects often have a practicing engineer act as the customer for the students [3]. These ideas have worked well for many students. Another venue is via service-learning projects where

the product of the students’ design experience serves the needs of others in the community.

One of the more familiar examples of service-learning is Engineers Without Borders, which specializes in sponsoring international projects on a broad basis [4]. A notable example of a smaller service-learning capstone design endeavor is the projects sponsored by the University of Evansville [5]. Rose-Hulman Institute of Technology has a history of sponsored capstone projects including international service-learning projects [6]. A potential disadvantage of international projects is the greater expenses and difficulties in coordinating the international activities. This paper will focus on service-learning projects with local communities.

One of the first and largest organizations to enable local service-learning is Engineering Projects in Community Service (EPICS) which was established by Purdue University in 1995 and has grown to a network of 20 participating universities [7]. Another notable organization is Service-Learning Integrated throughout a College of Engineering (SLICE) which was established by the University of Massachusetts Lowell in 2004 [8] and the Assistive Technology Program of the Electrical Engineering Department at University of Massachusetts Lowell [9]. These organizations have significant backing by large universities and EPICS has a record of successful grant awards. The size and resources of these organizations has enabled a degree of success that the many smaller universities involved in service-learning projects may not be able to match. EPICS also sponsors service-learning experiences for lower division students as well as capstone design projects. Both provide a broad array of service-learning projects for students. However, almost all of the EPICS projects do not have a focus on assistive technology. This paper will focus on those service-learning projects involved in applying engineering students’ capstone design learning to projects with a focus on the development of assistive technology. Assistive technology has been defined as developments which require adaptation of existing technology or design of new devices to meet the

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specific needs of a disabled person [9].

Smaller universities may find it challenging to find appropriate service-learning projects for their capstone design students – especially those with limited networks of personal connections. Many existing organizations including EPICS and SLICE established the outreach to community non-profits to find the needs which could enable a suitable student capstone design experience [10], [11]. Another similar example is the Center for Community Service-Learning at Cal Poly Pomona [12]. Several national organizations offer information to promote the development of assistive technology as part of student service-learning. These include Ability One, the Generator School Network, and the Rehabilitation Engineering and Assistive Technology Society of North America (RENSA) [13], [14], [15]. All three serve as information sources and both Ability One [16] and RENSA sponsor student assistive design competitions. These significant efforts still may fall short in connecting community non-profit needs with students interested in assistive technology, service-learning projects. Indeed, this was the author's experience. Although customer needs are at the core of successful developments, the literature offered few concrete examples of a non-profit approaching a university to establish service-learning collaborations. One of the few examples was Mustard Seed Communities (MSC) approaching Penn State to establish an international service-learning collaboration [17]. This led to the design and construction of a school for disabled young adults.

Given the challenge for instructors to find good project sponsors for their students' capstone projects and the unfilled assistive technology needs of some non-profits, a novel organizational model may offer some opportunities for both parties. The remainder of this paper describes this collaborative organization to enable capstone projects which serve non-profits. The paper will then examine a sample project from this endeavor, and finally will discuss some of the fundamental elements which are considered to be the drivers of the success of this venture.

II. CAPSTONE PROJECT INNOVATION

New York State Industries for the Disabled, Inc. (NYSID) established Project CREATE (Cultivating Resources for Employment with Assistive Technology). NYSID is a not-for-profit member organization that represents 177 community rehabilitation agencies and their corporate partners. Its mission is "turning business opportunities into jobs for New Yorkers with disabilities." NYSID has helped create sustainable employment for dependable, highly motivated and well trained New Yorkers with disabilities since 1975. In 2013, NYSID Preferred Source contracts employed 6,941 individuals with disabilities, working 4.1 million hours and earning more than \$55 million.

NYSID launched Project CREATE as an academic challenge to encourage assistive technology innovation for New Yorkers with disabilities in order to remove barriers from the workplace, in coordination with member agencies such as Goodwill Industries of Greater New York & Northern New Jersey (GIGNY).

Project CREATE collaborates with instructional faculty at universities to identify student teams who need a design experience – whether in engineering or business disciplines. Project CREATE then coordinates with member agencies to identify needs which may become possible capstone projects. These needs tend to be of a technical nature, which the member agencies have limited resources to address internally. The coordination includes involvement of the instructional faculty to aid in developing the scope of the projects to fit students' abilities and needs prior to down-selection. Once the capstone projects are launched early in the students' fall semester, the students visit their "customers" at the sponsoring member agency and begin their open-ended design project that is driven by the customer's need. Personnel at the member agency offer their time to serve as the customer to the students. They also grant the student teams access to their facilities and the people working there to enable the students to formulate the detailed specification for their designs. Students perform their design work and present their solutions to their customers at the member agencies. Students post project information onto their team's Facebook pages to better enable communication. Upon approval of the design, Project CREATE provides funding for prototyping. Member agencies enable students to test their prototypes with people at the customer's work site. At the end of the semester, students deliver their assistive technology to their customer with their final presentations.

A wider Project CREATE student capstone project symposium is being considered for this year's participants. Small-scale competitions, such as best poster, are being considered instead of a regional design contest. A large-scale design contest has not been applied as the projects and customers' needs are widely diverse, which makes uniform scoring difficult at best. Instead of having one winner, Project CREATE has grown with a win-win-win strategy for all of its stakeholders. The member agencies gain valuable assistance in helping their population gain employment. The students have a valuable design experience while gaining an appreciation for public service. In addition, the public awareness that is essential for thriving human service organizations is enhanced as Project CREATE by its nature involves a large group of people who are introduced to the work of these social service agencies. Examples of published wider communications include the NYSID website [18] (and publication in the alumni newsletter of SUNY Maritime College – a collaborating university [19]).

NYSID took the lead in developing Project CREATE and the mechanical engineering capstone design instructor at

SUNY Maritime, (the primary author) was the first school to collaborate. Project CREATE was launched with two capstone projects with mechanical engineering students at SUNY Maritime, which were sponsored by a local member agency – Goodwill Industries of Greater New York & Northern New Jersey (GIGNY). One project was to enable sight-impaired people to label clothes for sale by modifying a tagging gun, and the other project was to enable operation of a standard heat sealing machine by people requiring wheelchair access. The two student teams completed these projects during the 2012-2013 academic year. The next section gives a more detailed look at the experience of the students and customers of the tagging gun project.

III. LAUNCH PROJECT: REDESIGN OF TAGGING GUN FOR GOODWILL INDUSTRIES OF GREATER NEW YORK & NORTHERN NEW JERSEY CUSTOMERS

One of the launch capstone projects of Project CREATE will be summarized in this section. A mechanical engineering student capstone design team from SUNY Maritime College modified a standard tagging gun for their GIGNY customers to use for attaching retail price tags to clothes. Project CREATE coordinated with GIGNY in identifying potential design projects during the summer of 2012. GIGNY then invited the SUNY Maritime capstone design course instructor to meet and discuss the scope of potential projects. One of the two chosen was the tagging gun.

One of GIGNY's ongoing operations is the re-selling of clothing. Part of the process of re-selling includes the attachment of price tags using a standard plastic fastener. This fastener is pushed through the fabric's seam using a standard tagging gun. The tagging gun (Avery Dennison® Mark III™ Pistol Tool) has a slotted, steel needle that is approximately 50 mm long and is anchored at the outer end of the tagging gun and a manual actuation lever on its grip handle [20]. See Figure 1 for an outline drawing of a typical tagging gun (with the students' design modifications). A fastener is attached to the fabric by the operator by applying the following process:

1. The operator firmly pushes the needle of the tagging gun through a seam making a small hole in the article of clothing.
2. The operator holds the needle in place, and squeezes a lever which runs the fastener down the slotted needle and past the hole in the fabric. Once through the hole, the fastener flares open to hold it in place.
3. The operator then pulls the tagging gun from the article of clothing removing the needle to complete the process.

Although this attachment process is simple, it had not been economically successful when the operators were sight-impaired. GIGNY wished to enable sight-impaired workers to successfully perform this operation – offering them employment opportunities, as well as improving the productivity of the re-sale operations. The student design

team was challenged with finding a simple and economical way to enable sight-impaired workers to perform the attachment process. GIGNY personnel set a benchmark for performance where the students' design will enable sight-impaired workers to perform the attachment process in half the time that they had been able to previously.

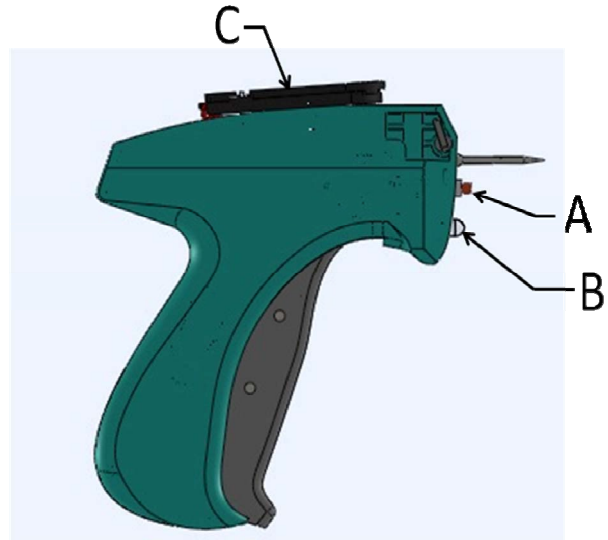


Fig. 1. Typical tagging gun showing needle on upper right-hand side. Students modified the design by adding a switch (A), auxiliary light (B), and battery energy source (C).

GIGNY personnel coordinated meetings of the design students and the sight-impaired workers, which enabled the students to refine their engineering design specification. The students carefully studied the attachment process and measured its time efficiency with groups of people with normal eyesight and groups with sight impairment. The students discovered that often, a plastic fastener would jam in the grooved needle of the tagging gun. Removal of this errant fastener is easy – if the operator has normal eyesight. Given the small size (approximately 0.5 mm in diameter) of the connector, sight-impaired people were often unable to remove the jam. This required assistance from other coordinating GIGNY personnel, as well as the lost time to remove the jam. These inefficiencies had prevented successful performance of this process by sight-impaired people.

Enlightened by the meetings with their customers at GIGNY, the students closely work with their sight-impaired customers to find the root cause for the jamming. Students determined that jamming was virtually absent if the entire length of the needle were pushed through the article of clothing. A partially inserted needle jammed at high rate. With this valuable, customer-driven insight, the students brainstormed designs to modify the standard tagging gun to enable their sight-impaired customers to operate the gun with the needle fully inserted. The students' solution was an elegantly simple switch, as shown in Figure 1, which was actuated only when the needle was properly inserted. This

switch closed a battery-operated electrical circuit, which gave an audible signal or a vibratory signal to the operator – letting them know that they could actuate the squeeze handle to successfully insert that fastener without jamming. A more detailed cross-sectional drawing showing the modifications is shown in Figure 2.

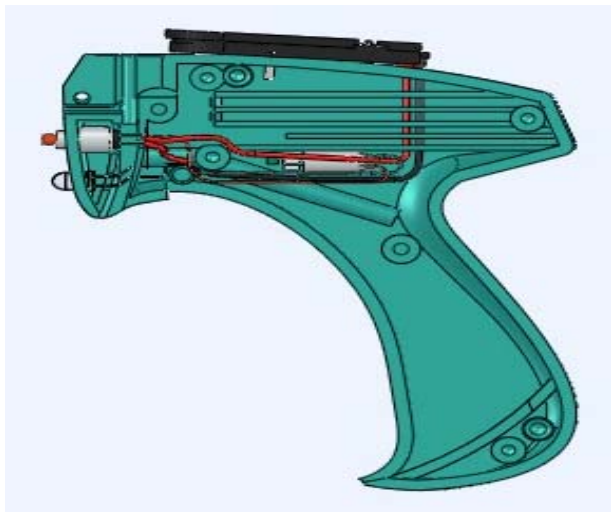


Fig. 2. Cross-sectional drawing of the modified tagging gun showing modifications and routing of electrical wiring (in red), vibratory signaler (white cylinder in center), and battery pack (in black on top). Standard needle (normally at upper left) not shown in this drawing.

Funds were provided to the students, enabling them to build several prototypes which were then tested by sight-impaired workers at GIGNY. Measurements revealed that the sight-impaired workers were at least twice as efficient – meeting and typically exceeding the benchmark. An example of a person working at GIGNY illustrates the success of the students’ innovations. A blind worker was asked to perform the attachment process on a standard (approximately 2.4 m long) rack of clothes using one of the students’ prototype modified tagging guns. When first inspecting the tagging gun, the worker was anxious after touching the 50 mm long needle. The GIGNY personnel encouraged this worker to try the process – even though a student observer was equally apprehensive. The worker was introduced to the switch on the modified tagging gun, and after some time to adjust, the worker attempted to perform the attachment process. After a little practice, the worker successfully performed the process on a rack of clothing. This individual was so happy about succeeding in the new task that this person didn’t want to go when the team was leaving for another remote work location. This person begged to stay behind and perform the attachment process on another rack of clothes!

Students completed their project by submitting working prototypes, final reports, and training GIGNY personnel to modify additional tagging guns as needed. This enabled sustainability for this assistive technology development. In addition to enabling local teams of sight-impaired workers to perform the process at local retail store locations, the students’

design may enable similar teams to perform this process at other locations regionally or even nation-wide. The positive change of spirit was also noted among the students. A student on one of the two design teams working with GIGNY encouraged his fellow students to “give back” during the team’s final presentation to all of the students in the capstone design class.

IV. DISCUSSION

The benefits of Project CREATE are multi-faceted enabling all stakeholders to benefit. The example student capstone design project (tagging gun) given in this paper illustrates the benefits for the students, the member agency (GIGNY) and NYSID.

Students had a challenging, open-ended design experience, which included several key elements that are vital to any successful design. Students worked directly with their customers who were not engineers. This enabled the students to hone their communications skills in a diverse human environment. The students’ design challenge was real and practical without an obvious solution. This open-ended design challenge enabled them to stretch their creativity and problem-solving skills. The real and practical design challenge with the need to serve a customer with whom they work personally offered students motivation to excel. Some of this motivation may have arisen from direct connection of helping an individual with technology, which too often seems impersonal. This connection may be a great way of maintaining some students’ interest in engineering programs – as some appreciated a personal connection to their work [5]. The need to build an operating prototype offers a very practical design and development experience to the students. In this age where digital technology may give the impression that the world is easily predictable, the construction of working prototypes enables students to understand the often important subtleties which must be addressed for successful design. These projects also provide a service-learning component. Although the technical education is the primary purpose of typical engineering programs, learning to appreciate the diversity of humanity is also important for personal and professional development. The students’ experience communicating and working with a diverse population enabled them to appreciate the potential of those with disabilities while gaining empathy and understanding of the wider spectrum of humanity.

The member agencies, such as GIGNY, gained practical and effective assistive technology, which enabled more people to work on mobile crews, increasing their workplace participation and the member agencies’ productivity. Project CREATE fostered these gains without having to expend scarce resources on outside consultants. The close participation by teams of students has spread the word about the work that GIGNY does. This awareness among today’s students will inform the leaders of tomorrow on the important role of human services non-profits in society.

NYSID raised awareness in many areas, better informing a wider spectrum of the public about the work of human service organizations and the needs, humanity and productive potential of individuals with disabilities. This publicity is vital in informing the public discourse on the importance of human service non-profits.

In summary, the Project CREATE organization was structured to enable this win-win-win operation for all of its stakeholders as the example project illustrated. Students learned; workers at member agencies (GIGNY) with disabilities were better enabled to expand their work productivity; and both member agencies and NYSID gained valuable publicity in support of their outreach missions.

The development and success of Project CREATE may have depended on multiple factors. The authors would like to share some thoughts on the most important of these factors. Project CREATE would not have been developed or launched without the broad foundation of:

1. The dedicated leadership of its primary champion with credibility in the non-profit sector:

The leadership of the second author led the effort of actively reaching-out to member agencies and universities. The first author observed a similar pattern with a successful series of sponsored projects by the U.S. Navy. This sponsor was a highly respected senior leader who actively reached-out to establish the collaboration. The second author's credibility stems from long-term, respected, non-profit experience, and this credibility also stems from NYSID's credibility as a not-for-profit member organization that represents 177 community rehabilitation agencies and their corporate partners.

2. A creative business development philosophy that widely connects people and organizations for a common good enabling all to succeed:

The Project CREATE model serves its stakeholders by providing personal and administrative connections between diverse organizations. The authors observed that the opportunities to collaborate have been present for some time and that the connections of Project CREATE have brought them to fruition. A business development thinking carried the effort forward to make connections; these connections are formed by key individuals with the experience, contacts and credibility to network with member agencies – enabling the collaborators to focus on contributing from their specialized abilities.

3. Collaboration and commitment by all stakeholders including time and resources:

All members stepped up to play their role in advancing Project CREATE including NYSID, member agencies, and universities. This commitment enabled the collaboration to succeed. Non-profits by nature are focused on helping people. This people-centered focus facilitates the contact time that

students need for the success of their projects. The drive for profit reduces the available time for students as time equals money. This focus has enabled Project CREATE to succeed. The first author's experience with a start-up sponsored capstone project contrasts the Project CREATE success. Despite the best intentions and enlightened design challenge, the collaboration could not be sustained as time was curtailed by the institutional survival instinct typical of start-ups.

4. Institutional stability:

Since 1975, NYSID has fulfilled its mission of "turning business opportunities into jobs for New Yorkers with disabilities." This stability helped enable Project CREATE to develop and succeed.

Within these broad elements, there are several tactical elements which enabled Project CREATE's success including:

- a. Early collaboration with faculty in the development of Project CREATE:

NYSID met with engineering faculty at colleges and universities, and staff at NYSID member agencies and corporate partners, to develop relationships and operating procedures that have come to fruition through Project CREATE.

- b. Active encouragement by NYSID for member agencies to participate:

Through a dedicated website, social media posts, outreach to higher education and NYSID members, and part-time interns, NYSID has actively recruited participating schools and agencies in Project CREATE.

- c. Forward planning by NYSID, member agencies and faculty to complete planning for the upcoming year's student projects prior to the start of the academic semester:

NYSID has proactively discussed Project CREATE with schools and agencies leading up to the academic semester and remained in frequent contact with them prior to the design and implementation of the student projects.

- d. Careful project scoping and down-selection with collaboration between member agencies and instructional faculty:

Pre-launch work to identify and scope projects takes effort and is vital, and NYSID and its member agencies engage with universities to complete this task.

- e. Timely prototype funding:

Participating teams are eligible for seed money to finance their CREATE projects and possibly put into production the winning technology that will transform the workplace environment. This timely funding (by using a simple gift card) enables students to complete prototypes within their limited academic schedules.

V. CURRENT IMPLEMENTATION AND FUTURE PLANS

NYSID member agency participants in the 2013-2014 academic year include: Fedcap Rehabilitation Services, Inc. (New York City); Goodwill Industries of Greater New York & Northern New Jersey (Astoria); AHRC New York City; YAI, Inc. (New York City); Lifespire (New York City), and St. Lawrence NYSARC (Canton); participating schools and universities include: Clarkson University, Manhattan College and SUNY Maritime.

This is the first year Manhattan College and Clarkson University are participating, so there are no stories about their projects as of yet. Manhattan College has one team working with Lifespire to develop an organizational system to sort clothes for the New York City Housing Authority (NYCHA). Clarkson University also has one team working with St. Lawrence NYSARC to develop a bottle redemption in-take and sorting table in a Potsdam facility.

As Project CREATE continues, NYSID and its member agencies seek functioning prototypes or systems that create greater access to employment or greater quality of life for people with disabilities in these areas:

- **Technology for special populations**, cognitive disabilities, learning disabilities, developmental disabilities, low vision/blindness, hearing impairments, dysphasia, elderly interventions, and service delivery programs;
- **Augmentative and Alternative Communication**, communication boards, and computer-based communication devices;
- **Computer Access and Use**, innovation in software and hardware, training strategies, integration of computer technologies, and alternative access;
- **Environmental Accommodation**, Environmental Control Unit systems, work-site modifications, ergonomics, farming and other rural interventions, universal design of products, and places and systems;
- **Functional Control and Assistance**, rehabilitation robotics, functional electrical stimulation, prosthetics, and orthotics;
- **Service delivery**, technology transfer, and telerehabilitation;
- **Seating and mobility**, seating and wheelchair interventions, seat pressure measurement, and transportation issues

VI. CONCLUSIONS

Project CREATE is a model organization which may be copied in other regions. Project CREATE offers the win-win combination of:

- I. a great capstone design service-learning experience for students,
- II. productive generation of assistive technology solutions to enable people at member agencies to perform new jobs and to better compete in the labor market, and
- III. a venue for participating not-for-profit organizations to

inform a broader cross-section of society on the needs of those with disabilities as well as the opportunities for involvement.

The authors observed that the successful development and launching of Project CREATE required:

1. the dedicated leadership of its primary champion with credibility in the non-profit sector,
2. a creative business development philosophy which widely connects people and organizations for a common good and enabling all to succeed,
3. collaboration and commitment by all stakeholders including time and resources, and
4. institutional stability.

The authors also observed that several tactical elements enabled Project CREATE's success including:

- a. early collaboration with faculty and member agencies in the development of Project CREATE,
- b. active encouragement by NYSID for member agencies to participate,
- c. forward planning by NYSID, member agencies and faculty to complete planning for the upcoming year's Student projects prior to the start of the academic semester,
- d. careful project scoping and down-selection with collaboration between member agencies and instructional faculty and
- e. Timely prototype funding.

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