Norwalk Community College's Plan
for Recruitment and Retention of Women
in Engineering and Engineering Technology

December 2018

National Science Foundation

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Vision

A diverse workforce is essential for the global competitiveness of US industries.

Mission

To increase the enrolment and the retention of women in Engineering Science and Technology Studies programs.

Why do we need more women in Engineering and Technology?

Industries around the world rank talent as the most critical driver of their global competitiveness [1]. With women comprising about 27% of the manufacturing workforce in the US, industry executives consider women workers as an untapped resource of talent that will help US manufacturers with their global challenges [2]. Diversity is a key factor for innovation by creating an environment where all ideas are heard and valued [3, 4]. Workforce diversity sparks creativity and competitiveness [5] resulting in better products, more efficient processes [6] and increased financial returns [7]. When the workforce reflects the population at large, every stage of product design and production is enhanced to consider physical and cultural differences in our population that may be missed by a team that lacks diversity [3]. Moreover, by hiring more women, industries expand their resources and address the issue raised by American business leaders on the inadequacy of the supply of qualified technicians that "threatening the nation's bona fide as the world's premier science and technology innovator" [8]. Many industries and organizations have realized this opportunity. General Electric's Balance the Equation program or The Manufacturing Institute's STEP Ahead initiative are examples of efforts to address this issue nationally.

The underrepresentation of women in Engineering and Engineering Technology (E&ET) fields is not from lack of preparation. There is no difference between male and female students in the average credit earned at high schools in core academic courses and, as shown in Figure 1, girls earn a higher GPA than boys do in these courses [9]. Girls are graduating from high school just as prepared to pursue STEM majors as boys, yet they are choosing other options. In the 2016 CIRP Freshman Survey, 12% of male respondent intended to pursue a career in the engineering field while only 3% of females expressed intention of choosing engineering careers [10].

The transition between high school and college is a critical moment when young women can be influenced in their decision to choose a technical career path. As an entry point into higher education, Community Colleges are well placed to provide this influence.
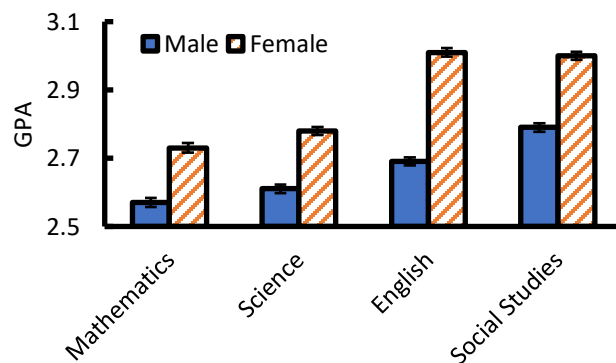
Figure 1 - Performance of high school students in core academic courses by gender in US in 2009 [12]

NCC's Baseline Data

NCC's Engineering Program comprised of two Associates of Science degrees: Engineering Science (ES) and Technology Studies (TS). These two majors respectively correspond to Engineering and Engineering Technology fields of studies. Throughout this plan, Engineering Program (EP) will be used to refer to these two programs collectively.

The data below represents retention, recruitment and enrolment data for EP in fall 2018. Retention was measured with reference to fall 2017 enrolment data.

In fall 2017, 13 women (out of a total of 116 students) were enrolled in EP (Figure 2) and 6 of them persisted and enrolled again in fall 2018, a retention rate of 46%. (Figure 3). Retention data for men is shown in Figure 4 for comparison. In total, 39 students were retained.

Figure 2 - Enrollment in fall 2017
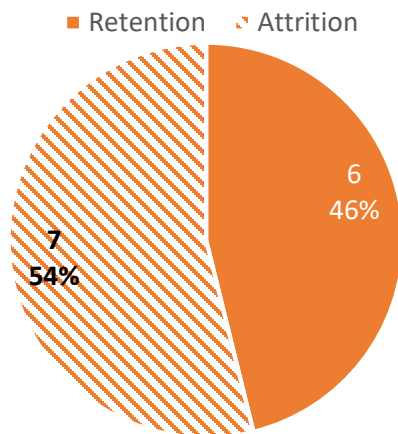
Figure 3 - Retention of women in fall 2018
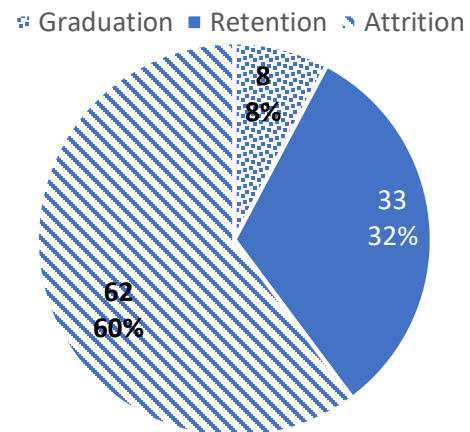
Figure 4 - Retention of men in fall 2018

We also recruited 4 women in fall 2018 (out of the total of 41 new students) which makes the current enrolment of women in EP, 10 students (out of 80 students). The data are presented in Figure 5 and Figure 6.
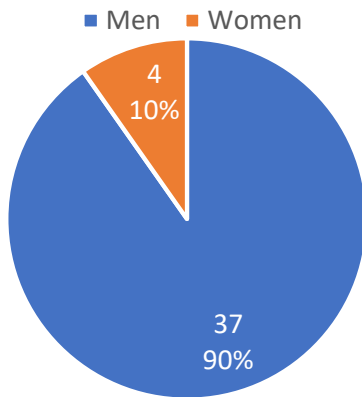
Figure 5 - Recruitment in fall 2018
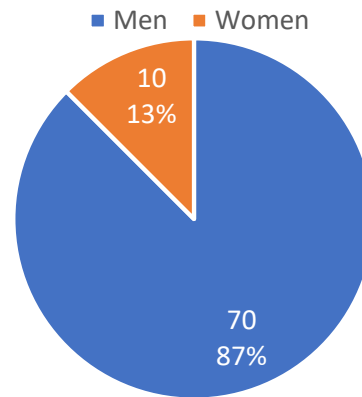
Figure 6 - Total enrolment in fall 2018

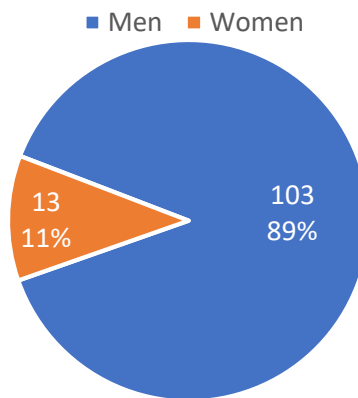## GOALS AND OBJECTIVES

The goal of this project is to answer the need for diversity in technician education and workforce development in E&ET fields in Fairfield County. The following two objectives will achieve this goal of the project:

- To increase enrollment of women in EP from the current 13% to 30% in three years
- To increase the retention rate of the women in EP from the current rate of 46% to 90%

We set the following short-term milestones:

Table 1 - Short-term goals of the project

	Retention	Enrolment
Fall 2019	50%	20%
Fall 2020	70%	25%
Fall 2021	90%	30%

ACTIVITIES

The NCC Engineering Program will revise its recruitment and retention policies and incorporate high-impact practices into its classrooms to achieve the objectives of this project by the following activities.

1   RAISING AWARENESS

For the success of this project, it is essential to raise awareness on campus and in the community to combat the stereotypes that hinder enrollment of women in E&ET and emphasize potential employment

opportunities. This objective will bring synergy to on-campus and off-campus activities and promote cooperation at different levels.

1.1   Present the project in all college meeting

There is no doubt that the success of the project depends on the support and cooperation of all NCC departments, faculty, and staff. To spread the word and seek support from the NCC community, the project PI will coordinate with the office of the president to present the project and its results at all-college meetings at least once every academic year.

1.2   Start and continue the conversations with key stakeholders

The following is the list of individuals who are identified as key stakeholders. Conversation with most of these individuals has been carried out. As a method to keep the community informed this plan or its future revisions will be handed to them individually by the project PI. At the same time, a 5-minute conversation will highlight the most important points of this plan for them.

- Mobin Rastgar Agah (PI), Nancy Fleming (co-PI), Forrest Helvie(co-PI)
- Mike Butcaris, Academic Dean
- Eli Glatt & Gabe Adamek, Mathematics Department
- Michele Barber & Phil Gee, Science Department
- Sue Burt, Professor of Engineering
- Suzanne Lyons & Rachael DiPietro, Institutional Effectiveness
- Bill Chagnan & Curtis Antrum, Admissions
- Karla Lara & Pracilya Titus, Student Retention Specialist
- Cathy Miller & Wendy Mendes, Student Counseling
- Kiran Somaya, Career Development Center

1.3   Present the project Result at departments and Centers

The following departments and centers are identified as the most influential in the recruitment and retention of the EP students:

- Counseling Center (Advising)
- Student Retention Specialist
- Mathematics Department
- Science Department

A more detailed presentation tailored towards the roles of the entities mentioned above will be carried out in spring semesters each year. The stereotypes surrounding women in STEM will be discussed in these presentations. While the focus of the presentation for the counseling center will be the recruitment techniques, for the retention specialists, the presentation will include out of classroom techniques that help female students continue their education in STEM fields. At the department meetings, the course curriculum enhancements that boost the retention rate of women will be presented. Additional departments and entities might be added in the future versions of this plan (see 2.2.2).

1.4 Host panel discussions on campus

The project will utilize resources at NCC CFT&L to host panel discussions between NCC faculty and staff and local stakeholders including

- local high school counselors and principals
- business owners and industry partner representatives
- local colleges and university admissions officers and faculty members.

Findings from these panel discussions will be documented and incorporated into future revisions of this plan. These panel discussions will be scheduled on the day Pamela Silvers visits the campus so she can contribute to the discussion as well.

2 RECRUITMENT

2.1 Identifying the target audience

The target audience for this project is divided into internal and external groups

2.1.1 Identifying the internal target audience and sending the invitation

The following students will be identified at the end of each semester starting from fall 2018 with a Banner inquiry request submitted to NCC's OIE. Invitation emails with further instructions on seeking an introduction meeting with the project co-PI will be sent to these students (see 2.3.3). We set a target enrolment of 5% and 1% from these groups and will measure these numbers after the enrollment freeze dates of the next semesters.

Table 2 - Internal Target Audience and enrollment goal for each group

Internal Target Audience	Enrollment Goal
Undeclared or General Studies female students with a B- or better in MAT 136 Intermediate Algebra	%5
Undeclared or General Studies female students with a C- or better in CHE 121 General Chemistry I	%1

Other target audience groups may also be identified and considered in the future revisions of this plan:

- Students enrolled in Summer Bridge Program
- Students enrolled in NCC's non-credit program
- ES students who do not finish that program can switch to TS.
- ESL student that show good analytical skills but lag in English and GenEd classes.
- Students referred by NCC faculty members, Counseling Center or Career Development Center
- Students referred by special programs on campus
- All new students may be reached during the orientation week (see 2.5).

2.1.2 Presenting for and identifying the external target audience

Our external target audience includes the students of the local high school:

- Norwalk High School

- Brien McMahon High School

With the help of Norwalk Public Schools, at every fall semester, we will set up presentations and information sessions at these school. While the PI is primarily responsible for the presentation, we will ask female STEM professionals to accompany the PI for these presentations. We will seek help from the school counselors to identify the candidates. A list of names of the students who attend the session will be acquired and keep for reference. Another avenue that can be pursued is a presentation at a science class which needs more coordination with school officials. We set a target goal of %2 enrolment from this group and will measure these numbers after the enrollment freeze dates in each semester.

Table 3 - External Target Audience and the enrolment goal for this group

External Target Audience	Enrolment Goal
Local high school female students identified by the career counselors	%2

The list may expand in the later revisions of this document to include Stamford high schools:

- Stamford High School
- Westhill High School
- Academy of Information Technology and Engineering
- J. M. Wright Technical High School

Other target audience groups may also be identified and considered in the future versions of this plan:

- Visitors at NCC's booth at Westport Maker Faire
- Women working in lower level positions at local industries
- Adult education institution in the community
- Women's organizations in the community

2.2 Design, create and distribute the outreach materials

This activity will start in fall 2018 with the goal of making the material available for 2019 fall recruitment. The material will be redesigned and reproduced as deemed necessary each semester afterward.

2.2.1 Creating and revising the promotional videos

The project will create a promotional video by taking advantage of Build Your Own (BYO) Recruitment Video resource available through South Carolina Advanced Technological Education's ATETV. The PI has already registered as a manager on the website to get familiar with the tool and be able to utilize it towards this project's objective. The video will be used in presentations and will be posted on the program website.

Furthermore, we will curate a database of videos that go "to the job site". The project team is aware of the powerful message these type of video has for students. Creating such videos from local companies can also be very helpful. The project team will discuss the idea with NCC public relations to weigh the possibility of creating such videos.

2.2.2 Creating and revising presentation slides

Presentation slides to introduce the programs with an emphasis on promoting ES & TS programs as well as CAD certificate to women will be designed and created. Several sets of slides will be available for different audiences:

- NCC students
- High School Students
- NCC faculty (with the focus on course curriculum enhancements)
- NCC counseling and admission staff (with the focus on recruitment)
- NCC retention specialist (with the focus on retention)

Additional sets of slides may be necessary for other audience in which case the presentations will be revised as needed.

2.2.3 Creating and revising pamphlets, posters, and flyers

The project will design and produce a retractable banner, pamphlets, posters, trifold brochures, and flyers (including tear-off flyers) to promote the project. The project will use templates that were received from IWITTS during the online training. The material will incorporate female-friendly aspects such as including pictures of women in professional engineering and technology positions and include co-PI's contact information and booking web address. The material will be revised and reproduced each semester afterward as needed. They will be used, distributed or posted at different locations:

- Engineering Program Coordinator office (pamphlets, flyers)
- Open advising sessions (posters, flyers)
- Counseling Center (trifold brochures)
- Admission Office (trifold brochures)
- Retention Specialists' offices (trifold brochures)
- Career Development Office (trifold brochures)
- Academic info boards (posters)
- Local High School Counseling Office (trifold brochures)
- Local events such as Westport Maker Faire (retractable banner, pamphlets, flyers)

2.3 Web-based outreach material and online campaign

This activity will start in fall 2018 with the goal of making the material available for 2019 fall recruitment. The material will be redesigned and reproduced as deemed necessary each semester afterward.

2.3.1 Creating and updating a webpage

With the help from the IT department, a page on the NCC website will be established at www.norwalk.edu/engineering for the engineering program. The page will be revised to exhibit examples of women in engineering and technical careers. In the next step, there will be a specific page to promote enrollment of women in CAD certificate and Technology Studies. The web address to these pages will be distributed to the target audience via invitation email.

2.3.2 Email address

Request for emails specifically for the engineering program and for this project will be requested. These emails will streamline the communication between students/parents with the program and this project.

2.3.3   Email Templates and distribution

Several email templates for each target audience group will be created and will be sent out each semester starting from spring 2019. The goal of these emails is to invite students for a personal conversation with the co-PI. An online booking mechanism, as well as links to program webpage, will be provided in the emails. To maximize the reach of these messages, they will be sent to both school and personal email addresses (if available). The options for the in-person or online meeting will be added. Other email templates will be prepared and distributed to NCC counseling staff and engineering faculty to be used in response to the inquiries from prospective students who contacted them. A document on Google Drive will be used to keep these templates and will be shared with users as necessary.

2.4   Creating a database of stereotypes and relevant conversations

Many times, the recruitment activities mentioned above should be followed up by a personal conversation with the student about the opportunities and possibilities of a career in engineering and engineering technology. One goal of this project will be to curate a set of personal encouragement conversations based on different situations and stereotypes that might come up. As the project progress, this database will be updated with conversation pointers that address the real obstacles raised by women in pursuing an engineering career. The conversation will include examples of the role models who have overcome these problems and bolster aspects of a career in engineering and technology that are more interesting to women, e.g., the opportunity to help the community and others. Information such as transfer rate or percentage of students who find jobs and personal stories (preferably from program alumni) will be included in the database.

2.5   Student activities and initiative

Mathematics department and Engineering program coordinated an engineering activity in orientation week during the summer of 2015 as well as the NCC Summer Bridge Program in 2015 through 2017. Relying on this experience, we start creating a database for activities that can excite female students about EP and encourage them to pursue this program. The database will also include a list of elements that need to be considered in designing the activities for women.

2.5.1   Summer Bridge Program

The NCC summer bridge program, help students who are eligible for Introductory Algebra to move on to Intermediate Algebra. We will include the engineering activities based on the database mentioned above in the Summer Bridge Program. This group of students might not be an ideal target group for engineering and engineering technology for the level of mathematics required for these majors; however, since it is already being carried out, the implementation of the activities is easier and can serve as a model for future summer activities.

2.5.2   Women in Engineering Meet and Greet

An information session mixed with hands-on activity with a 3D printer or laser cutter will be designed to attract women to EP. The meeting will be advertised to target audience via email and to general population via flyers posted on campus. For all these activities, a sign-up mechanism (such as Google forms or Eventbrite) will be provided to help with tracking and follow-ups. Also, it is important to have "space is limited" phrase on all promotional material related to these events when applicable.

2.5.3　Group activities during orientation week

Based on the experience with the Summer Bridge Program, and with the help from the dean of students, we will include the activity in orientation week.

2.5.4　Summer Engineering workshop

The project familiarizes students with engineering and engineering technology through fun and interactive activities and projects. The workshop will also serve as a place to teach the basic building block skills (see 3.8 below). It will be advertised to the target audience (see 2.1) as well as current and incoming NCC engineering students.

2.6　Involving high school counselors

Relying on the current relationship between NCC and Norwalk Public Schools in other projects such as NCC's Perkins Grant, we will recruit high school counselors as the advocates of the project. This activity will be divided into two sets of activates:

2.6.1　Conversations on high school campuses

Along with a presentation on high school campuses (see 2.2.2), one-on-one discussion with the counselors will be our main recruitment strategy. The goal of the conversation will be to break the ice and establish a personal and direct line of contact between the project and the counselors.

2.6.2　Workshops on NCC campus

Starting from fall 2019, we will invite three counselors from the local high schools to attend a workshop on NCC campus so that they become an advocate of ES, TS, and CAD programs for their female students and encourage them to take the Contextualized Intermediate Algebra course (see 3.7). Targeting key counselors and establishing a personal line of contact for invitation and discussion of specific needs and concerns for each invitee is essential for the success of this activity. We will take advantage of the promotional materials especially videos and short movies that will be created by this project or are available from other ATE projects. The workshop will include

- a short review of NCC E&ET programs
- a quick tour of the campus and facilities
- discussion of NCC's strategies in recruitment and retention of women
- explanation of the Importance of increasing women in these fields
- presentation of how rewarding E&ET careers are for women and bringing up the success stories
- fun and introductory CAD activity
- Practicing encouraging personal conversations that counselors could have with the students
- Providing a handbook to address questions and concerns of the counselors and that can be referred to when needed

3　RETENTION

3.1　Academic performance

Academic advising has been cited as one of the factors that directly affect the retention of women in STEM majors [16]. Several aspects of the advising session will be improved:

3.1.1 Setting up academic advising

At the beginning of each semester, a list of women enrolled in the programs and the courses they are taking will be requested from NCC's OIE. Emails will be sent to students individually to make an appointment for advising. The advising will include initiating/revisiting students' academic plan as well as discussion on their experience in the program and how it can be improved. This session will also be used to encourage the students to participate in several activities that are designed especially by this project.

3.1.2 Monitoring students' progress

At the end of each semester, the list with the final grades will be requested and students' progress will be monitored. In case a student did not pass a course or received a c grade or lower in STEM courses, an intervention session will be scheduled with the student by email and if necessary by phone. In case necessary, the student will be directed to other resources on campus. NCC's Student of Concern form might be utilized if needed.

3.2 Inviting role model speakers and mentors

Female role models in the E&ET fields has been cited as a factor that helps break stereotypes and increase retention of women in E&ET programs [15]. We will contact women engineers and technicians in the region to speak on campus to students at least twice each semester. The talking points will be discussed with the speakers before the speech to ensure the talk will reflect on stereotypes and possible issues that might negatively impact the enrollment of women in these fields.

Speakers will be asked to take the role of a mentor as well. Female students in the program will be connected to the mentors. Students and mentors will exchange contact information so that the students can get the opportunity to ask their questions and share their concerns directly with these mentors.

3.3 Providing internship and job shadowing opportunities

Providing a first-hand experience of working in the field via internships or job shadowing can help the students better understand the work environment and prepare before graduation.

3.3.1 Revising the curriculum and creating the documentation

Also, during the academic year 2018-2019, the ES & TS curriculums will be revised to include an internship as a credit course towards the degree. We will design a more detailed guideline and forms for internships. In brief, the guideline will address the followings:

- first-day orientation for the students by the company
- identifying students' supervisor
- providing a direct line of communication between the supervisor and the EPC
- ensuring a learning work experience for the students
- means and timing of providing feedback on students' performance
- completing the students' evaluation forms
- defining performance objectives or the students
- possibility and timing of the visit by EPC
- seeking timely reports from students about their work

3.3.2 Recruiting students for internships and job shadowing

The project will rely first on the advisory board to provide job shadowing and internship opportunities. We will seek further help from our advisory board and NCC's Center for Career Development to identify industries that we can work within this regard and communicate the opportunities to the students and specifically women in the program.

3.4 Identifying Gatekeeping classes

Gatekeeping classes are defined as classes that

- either more than 30% of EP students do not succeed
- or percentage of fails for women is significantly higher than men

An inquiry to Institutional Effectiveness will identify these courses. These courses will be at the top of the list for course delivery enhancement (see 3.7) as prescribed by this project and the faculty members teaching these courses will be particularly invited to panel discussion and workshops (see 3.5).

3.5 Hosting workshops for faculty and staff

Areas of modification and enhancement in course delivery and the class environment are listed below (see **Error! Reference source not found.**3.7). To educate the faculty members and encourage them to incorporate the modifications in their course, workshops will be hosted on campus. For conducting the workshop, we will mainly rely on resources available through ATE centers and projects such as CalWomenTech, Skilled Workers Get Jobs 2.0 projects, NGCP, Collaborative for Gender Equity, FLATE, RCNGM, and OP-TEC, and invite PI's and co-PI's of these projects on campus for running the workshops.

We will invite Pamela Silvers on campus for a discussion on the project progress as well as conducting separate workshops for staff/administrators and full-time/part-time faculty. Beside this, there will be a more focused workshop for faculty members.

Intermediate Algebra as the first course that will go through the redesign process will be a model for the other courses (see 3.7). We will work with the faculty members and help them in the implementation of these strategies. Such modifications will be tracked regularly at each semester. Courses such as Introduction to Engineering and Programming for Engineers are on top of the list.

3.6 Ensuring student persistence in STEM classes

These set of activities focus on strategies that can ensure all students, including women, are persistence in STEM classes. These activities include what can be done in the classroom to help the students feel welcome as well as providing access or teach skills the students need to be successful. Future advancement in this plan may include activities in the classroom during the first week that instill confidence in students.

3.6.1 Curating and promoting first-day activities in the classroom

We will encourage faculty to speak to students on the first day on practices that help them be successful in the course rather than how they would fail. Ice-breaker activities suitable for the first day of different classes will be curated and distributed on campus.

3.6.2   Teaching time management in class

The PI will work with the tutoring center to include a time management component in Introduction to Engineering class.

3.6.3   Increasing collaboration in the classroom

We will encourage faculty members to include collaborative work in their classrooms. To promote this aspect, we start by gatekeeping classes and identify lessons that can be transformed into a collaborative activity. We will help the faculty members to design and implement the lesson plans. This idea will be implemented in Intermediate Algebra first as a pilot course.

3.7   Providing Context in Intermediate Algebra

The Intermediate algebra course will be the pilot course for a contextualized course that appeal to women. While keeping the learning outcome and topics the same as any other Intermediate Algebra course, the contextualized version will introduce problems that are related to engineering and technology field while keeping the interest of female students (helping others, improve society) in mind. Examples are topics related to contemporary issues such as climate change, clean water, food production, robotics, transportation infrastructures.

We will take advantage of previous ATE projects that worked on contextualized mathematics courses and contact the PI's for help and advice: The list will be updated for the future versions of this plan.

- The Needed Math Project, PI: Dr. Hacker
- OP-TEC, PI: Mr. Hull on
- Project InnovATE, PI: Dr. Mercer

3.8   Building Block Skills

Building block skills are defined as the skills that are assumed for the student upon entry to the programs. As the informal STEM experience differs for female and male students before college, women might be at a disadvantage at some of these skills. The following are identified as the Building Block Skills for our target audience:

- Problem Solving
- Spatial reasoning
- Hands-on activities
- Tools identification and use

In a collaboration between NCC MakerSpace, Engineering Program, and Mathematics department, the curriculum for these skills will be designed. The delivery will be in the form of several short workshops at the makerspace. These workshops will be implemented further in Summer Engineering Workshop (see 2.5.4). Some resources identified to help with developing the curriculum are as follows:

- Developing Spatial Thinking by Dr. Sheryl Sorby, https://www.higheredservices.org/
- Purdue Spatial Visualization Test for pre and post tests

TIMELINE FOR ACTIVITIES

Activities	Year 1	Year 2	Year 3
Present the project in all college meeting	Dec 18	Sep 19	Sep 20
Start and continue the conversations with key stakeholders	Mar 19	Oct 19	Oct 20
Present the project Result at departments and Centers	Apr 19	Apr 20	Apr 21
Host panel discussions on campus	Feb 19	Feb 20	Feb 20
Identifying the target audience			
Identifying the internal target audience and sending the invitation	Jan 19	Jan 20	Jan 21
	Jun 19	Jun 20	Jun 21
Presenting for and identifying the external target audience	NA	Nov 19	Nov 20
Design, create and distribute the outreach materials			
Creating and revising the promotional video	Jun 19	Jun 20	Jun 21
Creating and revising presentation slides	May 19	May 20	May 21
Creating and revising pamphlets, posters, and flyers	Mar 19	Mar 20	Mar 21
Web-based outreach material and online campaign			
Creating and updating a webpage	Feb 19	Jul 20	Jul 21
Email address	Oct 18	NA	NA
Email Templates and distribution		Ongoing	
Creating a database of stereotypes and relevant conversations		Ongoing	
Student activities and initiative			
Summer Bridge Program	Aug 19	Aug 20	Aug 21
Women in Engineering Meet and Greet	NA	Nov 19	Nov 20
Group activities during orientation week	NA	Aug 20	Aug 21
Summer Engineering workshop	NA	NA	Jul 21
Involving high school counselors			
Conversations on high school campuses	NA	Nov 19	Nov 20
Workshops on NCC campus	NA	Mar 20	Mar 21
Academic performance			
Setting up academic advising	Oct 18	Oct 19	Oct 20
	Feb 19	Feb 20	Feb 21
Monitoring students' progress	Jan 19	Jan 20	Jan 21
	Jun 19	Jun 20	Jun 21
Inviting role model speakers and mentors	NA	Sep 19	Sep 20
	Nov 18	Oct 19	Oct 20
	Feb 19	Feb 20	Feb 21
	Mar 19	Mar 20	Mar 21
Providing internship and job shadowing opportunities			
Revising the curriculum and creating the documentation	Apr 19	NA	NA
Recruiting students for internships and job shadowing		Sep 19 and ongoing	
Identifying Gatekeeping classes	Jan 19	Jan 20	Jan 21
	Jun 19	Jun 20	Jun 21
Hosting workshops for faculty and staff	Dec 18	Dec 19	Dec 20
	Apr 19	Apr 20	Apr 21
Ensuring student persistence in STEM classes			
Curating and promoting first-day activities in the classroom		Ongoing	
Teaching time management in class	NA	Sep 19	Sep 20
	NA	Feb 20	Feb 21
Increasing collaboration in the classroom	NA	Jul 19	Jul 20
Providing Context in Intermediate Algebra	NA	Ongoing	
Building Block Skills	NA	Sep 19 and ongoing	

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