

**Quinsigamond Community College
@Scale Advanced Robotics Intensive Collaborative
Final Report
December 31, 2015
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I. Basic Information

Project Name: *Quinsigamond Community College @Scale Advanced Robotics Intensive (ARI) Collaborative*

Project Director: Betty Lauer

Phone: (508) 854-2765

Email: blauer@qcc.mass.edu

Award Date: for Calendar Year 2015

Award Amount: BHE \$50,000

Original Proposed Budget: \$110,782

Funding Received: Calendar Year 2015

FY15 (January 1 to June 30, 2015):

MA BHE - \$25,000

St. Gobain - \$5,000

QCC Foundation - \$5,800

RECF - \$8,250 (kit donations)

Intel - \$2,250

Competition Donations - \$4,795

TOTAL: \$51,095

FY16 (July 1 to December 31, 2016):

MA BHE - \$25,000

RECF/Northrup Grumman - \$9,300 (\$9,300 competition resources donations)

eSTEM - \$2,850 (training donations)

EMC - \$25,000

RECF/Intel - \$5,000

Greater Worcester Community Foundation - \$7,600

TOTAL: \$74,750

Project Background: Quinsigamond Community College (QCC) coordinates an out-of-school robotics program for students in the Worcester, Worcester County, and other public school districts throughout the state. This program, known as Advanced Robotics Intensive (ARI), currently reaches over 2,750 students yearly from grade 4 through grade 12. The ARI program mostly utilizes the inexpensive and reusable VEX robotics educational platform to teach a curriculum of STEM-related topics (engineering, structural design, materials, technical writing, electronics, programming, etc.) integrated with 21st century skills (problem solving, strategy, collaboration, teamwork, communications, etc.) through hands-on project-based activities. The purpose of ARI is to increase student interest in STEM careers and build a pipeline of opportunities from elementary, middle and high schools to college and ultimately into the STEM workforce.

Project Activities: QCC provides the following resources and opportunities to participating ARI schools:

- Professional development for teachers/coaches, who in turn implement at their respective schools,
- Technical assistance to teachers and coaches by QCC faculty and/or QCC student mentors,
- Curriculum components,
- Centralized web site for facilitating program activities and participants, including evaluation,
- Robotics kits, parts, team registrations, and game pieces/obstacles,
- Exposure to QCC faculty and industry engineers,
- STEM career awareness, college program exploration, and admissions information,
- Field trips to STEM-related industry to see technology in action, and
- Robotics kickoffs/competitions.

As a result of participating in QCC's ARI program, each member school is positioned to:

1. sustain and enhance Robotics technology, methodology and equipment within the existing curriculum at virtually no cost and
2. expand STEM courses and afterschool activities, making Robotics and STEM related subjects accessible to all students.

II. Goals and Objectives

The Advanced Robotics Intensive (ARI) project targeted the following goal from the Massachusetts STEM Plan, STEM 2.0: Expanding the Pipeline for All:

- Goal 1: Increase student interest in STEM

Secondary to that goal, were several goals that supported the Quinsigamond Community College's Strategic Plan Revision/Extension 2014-2017 Pathway to a New Prosperity, Strategic Priority: Community Outreach and Enrollment Optimization, Objective 2.4 - K through 12 and Vocational Technical High School Partnerships and Collaborations:

- Goal 2: Increase the number of students who enroll in college or major in STEM fields
- Goal 3: Produce Best Practices Model that includes a training module for educators and contributes to research in the field of K-12 STEM training and education
- Goal 4: Improve economic prospects for participants and their families

Since its inception in 2006, QCC's ARI Program has assisted in the development of robotics programs at 74 schools. Of the 36 schools that were funded by @Scale, three schools are currently inactive (Walpole, West Boylston, and Triton). All three of these situations were due to similar causes of loss of robotics teacher/champion due to illness, retirement, or change in position. QCC has reached out to these inactive schools in an attempt to restart programming with new teacher/champions.

Most recently, with calendar year Phase II @Scale support, the ARI Project partnered with the following new *Collaborative Schools*:

1. Blackstone-Millville Regional High School, 175 Lincoln St., Blackstone, MA 01504
2. Marlboro High School, 431 Bolton St, Marlborough, MA 01752
3. Carver High School, 60 South Meadow Rd, Carver, MA 02330
4. Old Colony Regional High School, 476 North Avenue, Rochester, MA 02770
5. Dracut Senior High School, 1540 Lakeview Ave, Dracut, MA 01826

6. North Andover High School, 430 Osgood St, North Andover, MA 01845
7. Roxbury Latin School, 101 St. Theresa Ave, Boston, MA 02132
8. Central Catholic High School, 300 Hampshire St, Lawrence, MA 01841
9. North Andover Middle School, 495 Main St, North Andover, MA 01845
10. Mountview Middle School, 270 Shrewsbury St, Holden, MA 01520
11. Wareham Middle School, 4 Viking Dr, Wareham, MA 02571
12. Westport Middle School, 400 Old Country Rd, Westport, MA 02790
13. Coelho Middle School, 99 Brown St, Attleboro, MA 02703
14. Carver Middle School, 60 South Meadow Rd, Carver, MA 02330
15. Normandin Middle School, 81 Felton St, New Bedford, MA 02745
16. Locke Middle School, 110 Allen Rd, Billerica, MA 01821
17. Immaculate Conception Middle School, 1 Washington St, Newburyport, MA 01950
18. Hopkinton High School *(one this year but several next year), 90 Hayden Rowe St, Hopkinton, MA 01748
19. Fairhaven High School *(restart), 12 Huttleston Ave, Fairhaven, MA 02719
20. St. Michael's School, 80 Maple Ave, North Andover, MA 01845
21. Julia Bancroft Elementary School, 3 Vinal St, Auburn, MA 01501
22. Jacob Hiatt Magnet School, 722 Main St, Worcester, MA
23. Elm Park Elementary School, 23 North Ashland St, Worcester, MA 01609

With Phase II @Scale funding, priority was given to the implementation of new schools' participation in the southeast and north-central parts of Massachusetts at the elementary, middle school, and high school levels. We focused on creating pipelines in areas (example adding middle school teams where there were already high school teams and vice versa). In addition, we began including elementary school teams where there were already existing middle and/or high school teams including two new elementary teams in the Worcester Public Schools.

During the 2012/2013 @Scale ARI Project, *Collaborative Schools* included (3 noted Inactive):

1. Walpole High School, 275 Common Street, Walpole, MA 02081 (*Inactive*)
2. Wachusett Regional High School, 1401 Main Street, Holden, MA 01520
3. Shrewsbury High School, 64 Holden Street, Shrewsbury, MA 01545
4. Shepard Hill Regional High School, 68 Dudley-Oxford Road, Dudley, MA 01571
5. Quabbin Regional High School, 800 South Street, Barre, MA 01005
6. Quaboag Regional Middle/High School, 284 Old West Brookfield Rd, Warren, MA 01083
7. Global Learning Charter Public School High School, 190 Ashley Boulevard, New Bedford, MA 02746
8. Greater New Bedford Regional Vocational Technical High School, 1121 Ashley Boulevard, New Bedford, MA 02745
9. Tahanto Regional Middle/High School, 1001 Main Street, Boylston, MA 01505
10. Triton Regional High School, 112 Elm Street, Byfield, MA 01922 (*Inactive*)
11. Southeastern Regional Vocational Technical High School, 250 Foundry Street, South Easton, MA 02375
12. Saint Peter Marian High School, 781 Grove Street, Worcester, MA 01605
13. West Boylston Middle/High School, 125 Crescent Street, West Boylston, MA 01583 (*Inactive*)

2006 to 2016 Worcester Area Robotics Collaborative include:

1. Worcester Technical High School, 1 Skyline Dr, Worcester, MA 01608
2. South High School, 170 Apricot St, Worcester, MA 01603
3. North High School High School, 150 Harrington Way, Worcester, MA 01604
4. Claremont Academy, 15 Claremont St, Worcester, MA 01610
5. Doherty Memorial High School, 299 Highland Street, Worcester, MA 01602
6. Burncoat High School, 179 Burncoat St, Worcester, MA 01606
7. Burncoat Middle School, 135 Burncoat St, Worcester, MA 01606
8. Worcester East Middle School, 420 Grafton St, Worcester, MA 01604
9. Sullivan Middle School, 130 Apricot St, Worcester, MA 01603
10. Claremont Academy Middle School, 15 Claremont St, Worcester, MA 01610

11. Forest Grove Middle School, 495 Grove St, Worcester, MA 01605
12. Seven Hills Charter Public School, 51 Gage St, Worcester, MA 01605
13. Spirit Charter School (Inactive)
14. Abbey-Kelly Foster Charter School (Inactive)
15. University Park Campus School, 12 Freeland St, Worcester, MA 01603
16. Chandler Magnet Elementary School, 525 Chandler St, Worcester, MA 01602
17. City View Elementary School, 80 Prospect St, Worcester, MA 01605
18. Clark Street Elementary School, 280 Clark St, Worcester, MA 01606
19. Goddard Elementary School, 14 Richard St, Worcester, MA 01603
20. Midland Park Elementary School, 18 Midland St, Worcester, MA 01602
21. Quinsigamond Elementary School, 14 Blackstone River Rd, Worcester, MA 01607
22. Rice Square Elementary School, 76 Massasoit Rd, Worcester, MA 01604
23. Tatnuk Magnet Elementary School, 1083 Pleasant St, Worcester, MA 01602
24. Woodland Academy Elementary School, 93 Woodland St, Worcester, MA 01610
25. Academy of Science, Technology, and Health, 420 Grafton St, Worcester, MA 01604
26. Framingham High School, 115 A St, Framingham, MA 01701
27. Walsh Middle School, 301 Brook St, Framingham, MA 01701
28. Cameron Middle School, 215 Elm St, Framingham, MA 01701
29. Fuller Middle School, 31 Flagg Dr, Framingham, MA 01702
30. Charles-Whitcomb Middle School, 25 Union St, Marlborough, MA 01752
31. Global Learning Charter Public School Middle School, 190 Ashley Boulevard, New Bedford, MA 02746
32. Belmont Street Community School, 170 Belmont St, Worcester, MA (Inactive)
33. Burncoat Street Preparatory School, 526 Burncoat St, Worcester, MA (Inactive)
34. Chandler Elementary Community School, 114 Chandler St, Worcester, MA (Inactive)
35. Norrback Avenue School, 44 Malden St, Worcester, MA (Inactive)
36. Girl Scouts of Central and Western Massachusetts, 79 Goldstar Blvd, Worcester, MA 01606 (RECF/Intel funded)
37. Girls Inc, 120 Providence St, Worcester, MA 01604 (RECF/Intel funded)
38. YWCA – Girls Choice, 1 Salem Sq, Worcester, MA 01608 (RECF/Intel funded)

In addition to the schools, teachers and students that are formally part of the @Scale ARI Collaborative, we also have schools that are not officially part of it, but have self-funded their involvement in some aspects – either professional development, kits, and/or teacher stipends. This allows them to take advantage of ARI structures and participate in ARI competitions, trainings, and/or field trips, with no additional cost to the @Scale ARI Collaborative. Each year, QCC hosts a variety of activities that support another 2,000 students from the region beyond the 2,750 directly impacted by the ARI Collaborative.

III. Implementation

Phase II @Scale of QCC's ARI Collaborative was more successful than ever. Implementation and scale were beyond target. We accomplished three major milestones in 2015:

- Established new collaboratives beyond Central Massachusetts:
 - Southeast Massachusetts: Led by Bristol Community College in support of 35 area teams and
 - North Central Massachusetts: Led by North Andover High School (potentially UMASS-Lowell eventually) in support of 35 area teams,
- Created new teams throughout Massachusetts: established 23 new schools mostly focused in southeast and north-central parts of the state, and
- Expansion into existing areas to development *pipelines*: established new schools (many elementary and middle school teams where high school teams already existed).

In addition, ARI Collaborative provided the following:

1. New robotics kits and equipment for 23 new schools (21 non-Worcester and 2 Worcester) through purchase with @Scale funds or secured donations through Robotics Education and Competition Foundation sponsors (such as EMC, Northrup Grumman, and Intel)
2. Four professional development opportunities for introductory, intermediate, and advanced VEX teacher/champions for 53 participants.
3. Two kickoff opportunities and 12 competitions opportunities and events at QCC for those schools to participate in
4. Developed and presented a three-week long summer camp for a limited number (44) of Worcester Public School and Framingham students.
5. Field trip opportunities to MIT Robotics Museum, STEM companies and specifically manufacturing companies utilizing robotics, and
6. Limited evaluation/survey at QCC's February/March VEX Robotics Competition event.

In addition to @Scale gains, teams involved that aren't formally a part of @Scale benefit from the size of the program and relationships (objectifying the notion of collaborative as being bigger than any single aspect of the project). We also notice that as we have supported the building of North Central Massachusetts and Southeast Massachusetts, some new schools/teams are joining on their own.

In addition, the ARI is the face of robotics in Massachusetts. The ARI collaborative of participating schools proves to be a strong and high-quality group of teams, both students and teacher/coaches. Although Massachusetts had the highest number of VEX robotics teams in any one state in 2007 and several states have outgrown them since, Massachusetts continues to grow in participation. Currently Massachusetts appears to be a powerhouse in robotics. With 14,000 VEX robotics teams throughout the world last year, Massachusetts housed approximately 340 of them, many directly supported through QCC and @Scale. All 340 teams participate at some level with QCC, either through competitions, sharing resources, and training. Some statistics that are important to note are:

- Over each of the past 9 years, multiple Massachusetts (QCC-sponsored) teams have qualified for the World Championship event, which currently the top 700 teams in the world are invited to.
- In 2015, QCC's Robotics Club won the VEX University World Championship,
- In 4 of the last 7 years, Massachusetts teams have won the World Championship in either the high school or university division. All of these teams played and qualified through QCC-sponsored events.
- At the 2013 World Championship, 3 Massachusetts teams made it to the top 5 alliances and Massachusetts alliances won the first (Worcester Technical High School) and second places and Worcester's Technical High School won the Excellence award.
- In 2009, Worcester's Doherty Memorial won the Design Award at the World Championship.

Massachusetts performance has dramatically increased over the past 9 years when most or all of the top teams were from China. QCC recognizes that the strength of our consortium improves our performance. This is reflected in the national view of the ARI program. QCC is often

invited to speak about the program, provide training to teachers in other states, judge at national and world championships, and teams from across the US will travel to participate at our events.

IV. Scale

The goals of Phase II @Scale ARI Collaborative were to

- Start 15 new schools – due to leveraging some donation opportunities, QCC actually started 23 new schools, at the high school, middle school and elementary levels.
- Established new collaboratives beyond Central Massachusetts:
 - Southeast Massachusetts: Led by Bristol Community College in support of 35 area teams and
 - North Central Massachusetts: Led by North Andover High School (potentially UMASS-Lowell in the future) in support of 35 area teams.

Although the 23 new teams were easily added and fit into our existing infrastructures (in one of the collaboratives), adding the new collaboratives required more effort in terms of resources (field supplies) and much training. However, in reality, adding these new collaboratives expands the infrastructure and allows Massachusetts to grow, in part, on its own relieving some of the strain on QCC as the major supplier of robotics activities for K-12 in Massachusetts.

In the future, the ARI Project is interested in:

- Priority 1: Continuing support of the existing ARI Collaborative in Central Massachusetts as well as the new collaboratives in Southeast and North-Central Massachusetts.
- Priority 2: Starting new collaboratives in the Boston and Springfield areas. ARI worked in 2015 with Boston Public Schools (BPS) to join our project, funded through a RECF/Northrup Grumman grant for a 3-year implementation of robotics kits in every school, however, BPS felt like they were not ready to do this.

Requests to join the ARI project from new Massachusetts schools continue. Some of these requests come through exposure to the program through the @Scale project while others continue to come directly to QCC and funding partners.

V. Outputs, Outcomes, and Evaluation

Accomplishments: The major accomplishments for Phase II was the expansion of 23 new schools (about 45 teams) plus the replication of QCC's role to other regional partners. The major accomplishment over the past 9 years is continued participation and growth from year to year in Worcester Public Schools, Worcester County, and throughout the state.

Challenges: Managing this project with a varying budget year to year is difficult. With limited space at QCC and high demand for these activities, we must continue to expand and create new collaboratives throughout the state. We must also seek funding to support the existing participation base and support modest growth. A recent development involved monetary support for teacher stipends for elementary school teachers in the WPS for the FY 2016. This is a deviation from the previous years when all robotics support for WPS's largest afterschool program came through QCC.

The ARI reaches 2,750 students directly throughout Massachusetts through the three existing collaboratives (Central, North-Central, and Southeast Collaboratives). Another 2,000 students from the region are reached peripherally through individual activities participation. ARI supports 80 robotics teacher/champions by providing professional development and limited technical and classroom assistance. In addition, ARI utilizes 150 STEM college students and working professionals as volunteer team mentors and/or competition judges.

Although QCC did not have funding to get outside support for a large scale evaluation as hoped at the beginning of this project, QCC did implement multiple surveys for teachers and students throughout the year, including our student participant survey utilized at our February/March Robotics Competition event (survey model designed in 2010 by the Donahue Institute at University of Massachusetts). This survey reflected:

- *Subject-Matter Pre- and Post-testing*: **82%** increase in knowledge of robotics subject-matter
- *Post-surveys on Increased STEM job interest*: **89%** of participating girls and **82%** of participating boys reported an increase of a little or lot
- *Post-surveys on 21st Century Skills*: Of the 14 aptitudes/qualities surveys, **100%** received large percentages of “helped a lot”

We recently established an updated agreement with the Worcester Public Schools to obtain student data for robotics students verses the general population.

VI. Budget and Plans for Program Sustainability

For the calendar year of 2015, ARI received the following donations:

FY15 (January 1 to June 30, 2015):

MA BHE - \$25,000

St. Gobain - \$5,000

QCC Foundation - \$5,800 (travel assistance to VEX World Championship in KY)

RECF - \$8,250 (kit donations)

Intel - \$2,250 (summer camp)

QCC Robotics Club Competition Donations - \$4,795

TOTAL: \$51,095

FY16 (July 1 to December 31, 2016):

MA BHE - \$25,000

RECF/Northrup Grumman - \$9,300 (\$9,300 competition resources donations)

eSTEM - \$2,850 (training donations)

EMC - \$25,000

RECF/Intel - \$5,000 (VEX IQ kits for girls)

Greater Worcester Community Foundation - \$7,600

TOTAL: \$74,750

QCC will continue long employed fundraising approaches to support the ARI program and @Scale gains, including renewing existing funding and seeking new sources, toward keeping the expansion numbers in place or even, to the degree possible, scaling ARI up further. Future funding anticipated includes from ongoing relationships with RECF, EMC, Daniels Foundation,

Greater Worcester Community Foundation, Intel, St. Gobain, and other possible sources under development.

The @Scale funding has been a significant incentive to enrolling new schools, teachers, and students in the ARI. @Scale funding has leveraged funding from private companies and foundations. This has especially been true in receiving robotics and competition equipment donations through the Robotics Education and Competition Foundation (RECF) and their supporting partners, such as Northrup Grumman, EMC, and Intel. In addition to the \$125,845 that QCC did raise, QCC In-kind donations (event facilities, maintenance, faculty, and other personnel costs) in calendar year 2015 to execute this program exceeded \$30,000.

There have been no unusual or unexpected costs or activities. The majority of funding was spent on new robotics kits and equipment for newly participating schools, followed by teacher/coach stipends for executing the after-school programming, and faculty and program coordinator funds for executing training and competition activities, and lastly, travel/transportation.

Account expenses to-date (Form 1a) (as of 12/15)

Form 1a: Expenditure Worksheet

Please complete the expenditure worksheet below. In the first column, identify how you divided your grant among the identified expense categories. In the second column, list your expenditures to date. The third column will automatically populate with the difference (remaining balance). Make sure to sign and date this worksheet before submission and include any necessary explanations or comments in the "Comments Box".

Instructions: Double-Click on the table for it to become an interactive spreadsheet. Click outside the table to return to MS Word. ONLY FILL IN CELLS HIGHLIGHTED IN YELLOW: Non-Yellow cells contain formulas and will fill in automatically. Also, all cells are formatted for currency; you do not need to type in \$ signs.

Categories	Grant Funds Received		
	Grant Funds Received	Grant Funds Expended	Grant Funds Remaining
Total Salaries:	\$ -	\$ 25,497	\$ (25,497)
<i>Administrator (Project Director)</i>		\$ 9,537	\$ (9,537)
<i>Support Staff</i>		\$ 10,920	\$ (10,920)
<i>Other (QCC student mentors)</i>		\$ 5,040	\$ (5,040)
Fringe Benefits		\$ 394	\$ (394)
Contractual Services		\$ 6,883	\$ -
Travel/Transportation		\$ 15,130	\$ (15,130)
Total Supplies & Materials:	\$ -	\$ 74,995	\$ (74,995)
<i>Curriculum</i>			\$ -
<i>Equipment</i>		\$ 57,776	\$ (57,776)
<i>Other (office supplies, food, shipping, registration)</i>		\$ 17,219	\$ (17,219)
Training		\$ 2,850	\$ (2,850)
Tuition & Stipends		\$	\$ (6,883)
Evaluation			\$ -
Indirect Costs (10% Max)			\$ -
Total	\$ 125,845	\$ 125,749	\$ 96

NOTE: This budget reflects the entirety of the ARI project budget for CY15. Some Stipends were paid as college employees (Support Staff) due to a preexisting employment relationship at QCC as well as Contractual Services.

Project Name/Organization: Quinsigamond Community College _____

Project Manager: Betty J. Lauer _____ **Date: February 8, 2016** _____