

ANITA BORG INSTITUTE FOR WOMEN AND FOR TECHNOLOGY'S

Virtual Development Center

Changing the World for Women and for Technology

1999 to 2005



THE VIRTUAL DEVELOPMENT CENTER

WHO SHOULD GET INVOLVED?

Colleges and Universities
Faculty, Students and Other Individuals
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VDC Sites
Project Summaries
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www.anitaborg.org/vdc
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The Virtual Development Center is a program of the Anita Borg Institute for Women and Technology

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The Virtual Development Center

Changing the World for Women and for Technology

I simply want to change the world.¹

With this clear vision, prominent computer scientist Dr. Anita Borg (1949–2003) embarked on a quest to bring women’s voices and values to technology creation and to match the benefits of technology to the needs of the world’s women and their communities. Believing technology will affect everything—our economic, political, social and personal lives—Anita fought tirelessly for the development of technology with positive social and human impact.

Anita’s vision was grand, her thinking was fresh, and her approach was ‘out of the box’. The Virtual Development Center, a unique program in the Institute which she founded and which now bears her name, is a vibrant result of that vision, and a legacy that continues to change the lives of many around the world.

Why Women and Technology?

TECHNOLOGY AFFECTS EVERYONE

Technology increasingly affects all dimensions of our lives, no matter where or how we live. From cell phones that have become a prevalent feature of our personal and business lives, rapidly evolving digital entertainment products, to more accurate global-positioning systems, technology pervades the culture of the developed world. Technology impacts everyone across the globe, directly and indirectly. And technology has an extraordinary potential for improving the human condition—from more accurate disaster forecasting to medical breakthroughs in diagnostics and health-care delivery.

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If we aren’t able to make technology work for everybody, is it worth doing at all?²

ANITA BORG

Anita Borg Institute for Women and Technology Mission

Increase the impact of women on all aspects of technology

Increase the positive impact of technology on the lives of the world’s women

U.S. Dept. of Labor⁶
Workforce Projections for 2012:

1.9 million new positions in professional, scientific and technical services occupations

487,000 new jobs as communication, information & computers systems analysts and managers (to total 1,677,000 overall)

307,000 new computer software engineers needed (to total 982,000)

18,000 new positions in environmental engineering (to total 65,000)

The key point is that the United States is facing a crisis of global economic competitiveness. It is essential that we draw on all the human capital in this country.

DENICE DENTON, CHANCELLOR,
UNIVERSITY OF CALIFORNIA SANTA CRUZ

But what are the problems technology is attempting to solve? Whose priorities are represented? How much of technology truly benefits the world's peoples? Who are the creators of technology?

In its 2002 report, the National Academy of Engineering and the National Research Council frame the discussion from a different perspective, the importance of technical literacy.

...democratic principles imply that decisions affecting many people or the entire society should be made with as much public involvement as possible. As people gain confidence in their ability to ask questions and think critically about technological developments, they are likely to participate more in making decisions. Increased citizen participation would add legitimacy to decisions about technology... [and] would also give policy makers and technical experts a better understanding of citizens' hopes and fears about technology.³

The creators of most of our current technology, however, represent a narrow stratum of the world's population – North American males. The important needs and problems that inform and drive technology are defined primarily from the experience and perspective of a few.

Most of the world's women do not have a voice in the design of technology solutions. Technology therefore does not represent their needs or those of their families and communities.

Anita Borg asserted, **"A positive future depends on what technology is developed, who designs it, who builds it, who controls it, who uses it, and how it's used".⁴** The world needs women to be involved in all aspects of technology.

DIVERSITY ENRICHES TECHNOLOGY

Women's experiences, perspectives and values are dimensions of diversity that are essential in the creation of new ideas and in the development of inclusive communication and management styles. Women's potential contributions to technology include more robust and innovative designs and solutions.

"Without diversity, the life experiences we bring to an engineering problem are limited. As a consequence, we may not find the best engineering solution. We may not find the *elegant* engineering solution. As a consequence of a lack of diversity, we pay an opportunity cost, a cost in designs not thought of, in solutions not produced" warns William A. Wulf, President of the National Academy of Engineering. "Opportunity costs are very hard to measure, but they are very real."⁵

THE ECONOMY NEEDS WOMEN'S CONTRIBUTIONS

Including women in the design of new technology will democratize technology for the benefit of the people of the world and will address opportunities lost. There are other urgent considerations too.

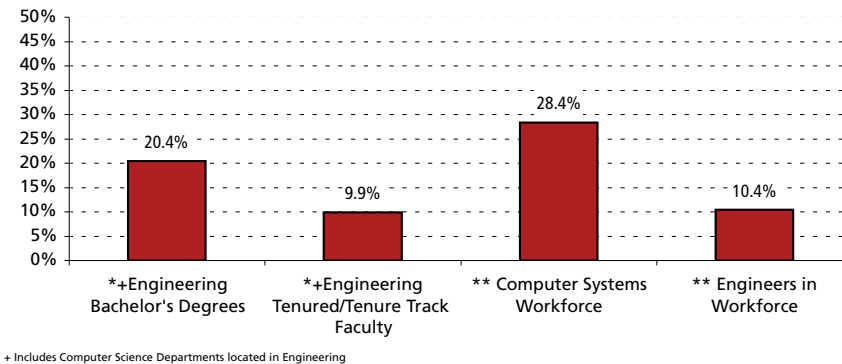
In the United States, changing demographics and impending labor shortages will critically affect our overall economic competitiveness.

By 2011, the 'baby boom' generation will begin turning 65, which will initiate a wave of retirements from the skilled and technical workforce. The accelerating exit of this North American generation from the workforce contrasts sharply with the burgeoning populations of technically trained people in China and India. As the nature and scope of technology continue to change dramatically and ever more quickly, fresh ideas and approaches are required.

Put simply, to advance the United States' capacity in innovation and to meet the rising demand for a technologically skilled workforce, it is essential that we maximize the talent and potential resource that all of our citizens offer – women and men.

In the U.S., however, women continue to be significantly under-represented in technical fields, as students and as professionals. While many gains were realized in the 1980s, over the last two decades progress has been slow, leveling off in some disciplines such as engineering⁷ while dropping significantly in other fields, such as computer science.

Percentage of Women in Selected Technology Fields 2003⁸



Undergraduate technical education plays a key role in developing and maintaining a highly skilled workforce. However, research shows that fewer than half the students who enroll in science and engineering (S&E) complete their degree. Furthermore, women and underrepresented minorities leave S&E programs at higher rates than men and non-minority students.¹⁰

Women's entry and persistence in science and engineering programs is motivated by more than just ability and interest. One key study found that over 90% of women surveyed cited altruistic reasons for choosing a major in science, math or engineering. This suggests that women's choice of major may be profoundly influenced by the value they place on social contributions.¹¹ Therefore, a key opportunity to increasing female student enrollment and retention, and ultimately national competitiveness, may lie in linking education and community benefit. **The Virtual Development Center makes this powerful connection.**

Increasing the numbers of women graduates in S&E fields will reverse recent declines, build a skilled domestic workforce, add the value of diversity to technology creation, and forge a stronger link with broad societal benefit.

The Virtual Development Center

The Virtual Development Center (VDC) was founded in 1999 as a program of the Anita Borg Institute for Women and Technology. The Institute is a nationally recognized non-profit providing platforms that position women's voices, ideas and spirits to influence technology.

Originally created as an Institute partnership with three universities and sponsors, the VDC is now a collaborative network of ten colleges and universities from across the country that draws technical and non-technical women and their supporters into technology by making the connection between technology creation and social impact. This connection is strongly established through the active engagement of local communities.

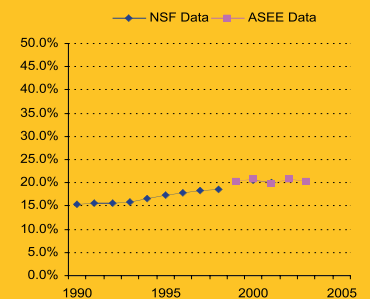
The VDC program addresses its objectives through project-based, service learning undergraduate engineering and computer science courses offered for credit at institutions of higher learning. In some cases, the academic course is pre-existing, and

37%



28%

Women's share of Bachelor's degrees in computer sciences from 1985 to 2001⁹



% Women's Engineering Bachelor's Degrees⁹

VDC Objectives

Develop a strong association between technology and its social relevance in the lives of VDC participants, including engineering and computer science students and community clients.

Develop appropriate technology solutions through student projects.

Identify and promote best practices for systemic change in academia and industry.

The VDC Network

Purdue University (1999)

Santa Clara University (1999)

Texas A&M University (1999)

Smith College (2000)

*University of Arizona, Tucson
(2000)*

*University of Colorado, Boulder
(2000)*

*University of California, Berkeley
(2001)*

*University of Washington, Seattle
(2001)*

*University of Texas at El Paso
(2002)*

*Notre Dame de Namur University
(2004)*

The VDC Unique Differences

*Projects based on ideas from
women*

*Innovation Workshop enhances
the participation of all*

*Community and team diversity
adds value to solutions*

in other instances, the course is created. These courses are adapted to the VDC model by the incorporation of the Innovation Workshop. Courses are offered at different levels in participating schools (e.g. first-year introductory course, senior capstone offering) and at differing times during their academic schedules.

Guided by several concepts and fresh communication processes, VDC participants create technology-based products that build on the ideas and vision of women of all ages and from all walks of life. By amplifying the voice and priorities of women, we strive to develop technology to benefit all people.

VDC PROGRAM COMPONENTS

The annual cycle at each VDC site begins with an Innovation Workshop in which local community groups meet with students and faculty to generate ideas for needs-based technology products. These external groups are predominantly female or provide service to women and their families. After completion of the Innovation Workshop, students spend one or two terms working with these community participants and professionals from applicable fields to develop appropriate technology-based solutions. The combination of the Innovation Workshop and the academic course constitutes a VDC course.

Students from the VDC sites present the results of their work from their VDC course at an annual VDC Conference held in the spring. In addition to presenting the technical merits of their project, students discuss challenges, offer possible enhancements for future teams, and develop relationships with potential employers and future collaborators. In turn, Institute sponsors enjoy the opportunity of being the first corporate representatives to interact with the VDC scholars, appreciating first-hand the context of their work, skills learned, products designed, and tangible contributions to community. By 2004, 427 individuals had attended the conferences which featured presentations on 120 projects.

The VDC Program is managed by a full-time Director employed by the Anita Borg Institute. In the first few years, the direction of the VDC was made possible through loaned executives from Compaq Computers (now Hewlett-Packard). From 1997–2001 the Institute offices were provided by Xerox Corporation. Since 2001, they have been provided by Hewlett-Packard.

Activities at each academic VDC site are managed by its own Leadership Team that includes technical and non-technical faculty, a higher administration sponsor, a community representative, an administrative assistant/coordinator, and others as needed.

An external Advisory Committee of experts from a variety of disciplines assists the VDC Director and site Leadership Teams in charting the future course of the VDC program.

HOW IS THE VDC A UNIQUE CATALYST FOR CHANGE?

Modeled after traditional service learning courses (e.g. the Engineering Projects in Community Service Program¹²), the VDC has developed distinctive teaching and learning methods which specifically work to engage women's perspectives and priorities in the generation of new technologies and applications.

Source of the Project Ideas: Instead of faculty—or student—generated topics, the ideas for the student projects come primarily from external communities, and predominantly from women or service organizations providing benefit to women. This is a direct and powerful way to bring women's priorities and voices to technology creation from the start.

These external communities are very diverse, ranging from battered women's shelters to rural healthcare providers (Community Groups page 16). These groups are composed

of individuals historically underserved by technology – especially women whose views and opinions are not typically considered when we speak of the creation of technology.

A recent example illustrates the rich diversity created when students work in partnership with such communities. In early 2005, an Innovation Workshop was held in a small town in the agricultural area of California’s Central Valley. The partnering community of migrant farm workers collectively brainstormed ideas with students on solutions to their critical safety and health concerns about toxic pesticides.

The participants—41 adults, two babies and a small black dog named Chico—gathered in a room behind a small local church. There was an immediate appreciation of the extraordinary range of countries represented by the workers, their families, students from two educational institutions, and the VDC staff: Mexico, Lebanon, Korea, UK, India, Peru, Colombia, Canada and the U.S. Age, language, life experience, socio-economic status, experience with technology, and level of formal education were similarly diverse. This is one example of how the VDC brings new participants to the creation of technical solutions to social problems.

Process of Engagement: A second key feature of the VDC is the **process** by which project ideas are generated from community members, together with students and faculty from the partnering academic institution.

To address the challenges that such diverse groups present, the Institute has developed its unique Innovation Workshop conducted at the outset of each design course. The Workshop establishes the tone and methods for the rest of the program, and launches a sustainable relationship between the community and the academic institution.

Informed by their own experiences, women and men of all backgrounds generate ideas for new technologies that would be helpful to them, their families, and their communities. Those individual experiences combine with adapted **Thinking Environment™**¹³ processes to truly engage all participants and improve the quality of the brainstorming.

The Workshop encourages people to think for themselves in a setting that values the ideas of each individual. Every participant is given full attention, everyone gets a turn to speak, the pace is easy, the physical space is comfortable, and appreciation is expressed.

Slowing us all down to attend to one another, by skillful means as in today’s workshop, is greatly needed in today’s world. Thank you for your commitment to this unfolding process. (Community participant)

The example of the migrant farm worker participants described above illustrates the benefits of the rich workshop environment. In spite of the challenges of conducting the event in both English and Spanish, there was open communication and respect for everyone’s ideas. The local participants were touched to discover that they are experts from whom the students and their professors want to learn and with whom they will continue to work. Students were equally moved to learn about others’ lives and to see the possibilities for positive change through appropriate technology.

The relationship to community doesn’t stop with the ideas generated at the Innovation Workshop. The students are responsible for continued communication and engagement with their community partners to ensure their needs are addressed at each stage of the development and delivery of the design/product, and to honor the role of the community.

Diverse Teams: A third unique quality of the VDC course is the multi-disciplinary make-up of the Leadership Team and the students. To bring the best competencies to address the areas of impact of the student projects, faculty members come not only from engineering and computer science, but also from non-technical fields such as the



The Challenges

Enable non-technical women to recognize their own competency in already using technology in their everyday lives.

Create a ‘level playing field’ where technical and non-technical people are equally confident to voice their ideas.

Sponsors support the VDC for diverse reasons

We want not only capable talent but a truly diverse workforce, because it leads to more creative invention and better problem-solving... We're interested in how technology enables people to work across distances... the VDC helps us learn more about this.

DEBRA DUNN
HEWLETT-PACKARD

[The Institute] is about a whole new process of thinking about technology, society, usability, and livability... [The] VDC holds breakthrough potential in terms of concrete product ideas as well.

GREG PAPADOPOULOS
SUN MICROSYSTEMS

...a VDC site seemed like a special opportunity for the strong technical women doing research and driving our product groups to get involved locally... More women in science will drive the success of computer technology. We're sponsoring [the Institute] to move everyone forward.

RICK RASHID
MICROSOFT RESEARCH

The innovation workshop process is a way to bring new high-level ideas into the research community and expand the variety of ideas considered...

ALAN EUSTACE
GOOGLE

humanities, social sciences, education or gender studies. Many VDC courses attract students from a variety of disciplines across their school—political science, business, communications, psychology, and education—and this mix introduces new perspectives.

Geographically distributed across the country, the participating schools are also characterized by aspects of diversity which underpin and enrich the work of the VDC. For example,

- Smith College is the only women's school to offer an undergraduate engineering program.
- University of Texas at El Paso has the largest Hispanic enrollment in the U.S.
- Santa Clara University has the highest percentage of female engineering faculty in ABET accredited institutions.
- Notre Dame De Namur was the first college in California authorized to grant the baccalaureate degree to women.

The VDC: Success by the Numbers

From three schools in 1999, the VDC has evolved into a growing network of schools offering VDC courses, a total of ten in 2005. Rich and comprehensive activities at these institutions across the U.S. have yielded impressive results. As of 2005:

- 31 Innovation Workshops were delivered to 800 students, faculty and community representatives.
- Over 370 students had completed VDC-related courses.
- Of the approximately 30 VDC courses, 14 were all-female; in most, women were the majority.
- Over 50% of Workshop participants were from external communities, with the majority of attendees being women or girls (74% in 2003–04).
- Over 1500 ideas were generated, ranging from a smart bus shelter addressing women's needs for safety and warmth, a whole family calendar manager, to a faster, safer way of moving wheelchairs on and off aircraft.
- Over 120 projects were undertaken, driven by needs from over 30 community groups.
- Over \$3M of Hewlett-Packard Company computer equipment has been donated, enriching the technology experience of students and community.
- Financial contributions have been made to the VDC by the Kellogg Foundation, Hewlett-Packard, AT&T Foundation, Microsoft, and Sun Microsystems.
- Numerous corporate employees have been directly involved as student project mentors and Leadership Team advisors.
-

The VDC: Success for People

The VDC experience delivers significant positive change for each of its partnering constituencies.

BENEFITS FOR STUDENTS

VDC students gain exposure in real design and delivery to a customer, but it is more than just a technical and project management experience. They benefit from increased engagement, absorb what engineering and computer science ‘do’, and discover their real-world connection. These are important factors in attracting and retaining women in technical education.

The VDC was a big step in keeping me interested in engineering. Being able to go out and have those interactions kept me interested and opened me up to the vast number of things I can do after I graduate. (Student)

In Innovation Workshop survey summaries for 2003–04, 89% of participating students indicated their experience with the workshop strengthened their decision to pursue their current major. Most of these students were juniors or seniors and presumed to be already committed to graduate. This outcome signals a potential for increase in the numbers of students finishing in engineering, as well as going on to graduate school.

Perception change is a key indicator of this increased engagement of students in technical fields. In pooled data from workshop surveys for 2003–04:

- 41% reported broadened personal understanding of what technology ‘is’,
- 79% realized that they can demand more of technology, and
- 67% revealed increased interest in creating technology.

Anecdotal evidence strongly supports that participation in the VDC is a significant motivator contributing to the retention of computer science and engineering students, especially women.

What makes an engineering student switch from saying, “I cannot wait to be done with my degree” to “I’m going for my Ph.D.”? One student, Catherine Newman, is a 2003 senior mechanical engineering graduate of the University of California at Berkeley who has completed a year of graduate school... [Catherine] says two things helped her commit to a Ph.D. program: defining engineering on her own terms and finding validation from the VDC.¹⁴ After attending an Innovation Workshop she said, “The workshop really had a powerful impact on me... I am serious when I say that if I had done this when I was a freshman, things would have been much different.” Catherine has published a paper based on research done in the class, and continues to be involved with the VDC.

The direct personal connection of the undergraduate curriculum to societal benefit and community also makes better engineers and computer scientists.

This project has helped me see that engineering is not just about sitting in the classroom all day but is instead about having interactions with community and having relationships with people. There were so many cultural subtleties we couldn’t have even seen, let alone understand, unless we had spent time with these women. (Student)

...when you can hear the ideas of the workers or clients, you see they are at least as good if not better than yours. If you’re not open to hearing those ideas, you miss opportunities. (Student)



Nobody ever told me I could tailor my engineering studies to my dreams and my personality... All the students in the class came out believing they could have some impact on the design process...

CATHERINE NEWMAN



The VDC experience brings the benefits of increased motivation, confidence, enhanced communication skills, and leadership development in the students.

...as a CS major I have always felt I would end up programming boring software, but now feel more that I can end up doing work that interests me. (Student)

More than anything, the VDC program is empowering. At my first Innovation Workshop, I realized how many things women have invented, how much we contribute to society. I felt inspired to be creative and dedicated, to be organized and meticulous and carry out a new idea to the finish. (Student)

The expectations are high. But at the end of the day, what I see in the students who participate in the VDC program is a jump in confidence. (Faculty member)

The students' dedication to the projects was something I'd never seen before in math-based computer science classes that I teach. (Faculty member)

The experience that the team members get by developing their projects is unlike any other experience in undergraduate engineering classes. And the exposure they get at the conference is wonderful. It helps them learn to value what they know and what they're doing. (Team advisor, former student)

Another positive outcome of the Workshop is the increased awareness of gender issues through the equitable interactions and cooperative learning among female and male students. In most design teams there is an environment of greater gender parity than is typical of engineering programs. At the end of a workshop with about 80 participants, two fourth-year male Electrical Engineering/Computer Science students offered:

[This was] My first time to be involved in open discussion.

The day was not about competition and the ideas just flowed.

BENEFITS FOR COMMUNITY

CHANGED ATTITUDES; INCREASED EMPOWERMENT

One of the important objectives of the involvement of community members in the VDC, particularly in the Workshop, is to change their attitudes about technology and their personal relationship to technology.

Workshop survey results for 2003–04 from community participants reveal that:

- 53% agree that their understanding of what technology “is” has been broadened,
- 88% affirm that they can demand more of technology,
- 68% are convinced that their views on technology are important,
- 80% have had their general interest in technology increased, and
- 74% report increased interest in creating technology.

The community participants gain an increased understanding of their own relationship to technology and the ability to better express their needs for technological solutions.

I have always felt passive about my relationship to invention and technology, whereas I now feel that I can choose to impact development. (Community participant)

I saw that I am more ‘technical’ than I realized. (82 year old female, retired professor of literature)

These students show that they have learned to view their growing technical expertise with a more critical eye towards the impact their work can have on the people around them. This context provides a valuable reference point for future decisions that students will eventually face as professionals.

GLORIA MONTANO
FORMER VDC DIRECTOR

NEEDS-BASED PRODUCTS AND DESIGNS

A key aspect of Anita Borg's vision is to provide real solutions and products to benefit broader populations. Students in the VDC courses from 1999–2004 contributed their imagination, energy and talent on over 120 projects to produce tangible benefits to community clients.



TOYTech is an elementary and middle-school collaboration that designs fun, marketable, gender-neutral toys that teach technology principles. As a result of their innovative project, Smith has partnered with the Sally Ride Science Club, toy manufacturer Hasbro and Sigma XI, the Scientific Research Society, to launch the outreach activity, TOYChallenge. (Smith, 2004)

The GO Boulder (Giving Online in Boulder County) project is an Internet database hosted by the Boulder Community Network to aid residents in making targeted in-kind donations to non-profits. The site also gives non-profits a way to coordinate activities and share furniture and other resources. (University of Colorado, Boulder, 2001)

The Tucson Community Food Bank expressed the need for an ergonomic assembly-line system for volunteers who pack thousands of boxes of food every month for distribution to needy families. The system that the team designed and implemented with the input of their client includes components such as ergonomic mats, a lifter, and assembly-line rollers. (University of Arizona, Tucson, 2004)

The Smart House PowerAid is an in-house real-time system to inform domestic shelter residents of power utilization for better financial management decision-making. (Santa Clara, 2004)



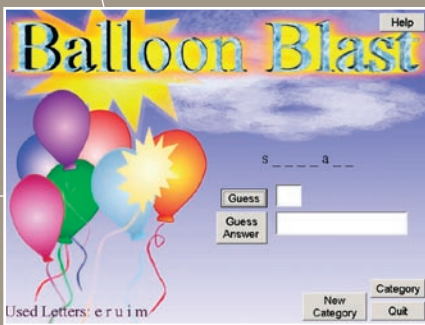


A Fingerprint Identification System for blood donors was developed to support United Blood Services to more efficiently and accurately track donations. (University of Texas at El Paso, 2004)

Remark is a visual-based communicator designed for hearing-impaired individuals to assist in their day-to-day interactions with non-hearing-impaired individuals. (University of California, Berkeley, 2004)

A suite of Internet products have been designed in a continuing partnership with community middle-school girls. They include an interactive collaborative paint e-Art Program and an education-based Trivia Board Game. (Purdue, 2004)

A newly redesigned website is used by CASA Latina, a community organization that empowers Latino immigrants. The site is now more attractive to donors and volunteers, and effectively highlights services to ensure a smoother transitional experience for immigrants. (University of Washington)



BENEFITS FOR FACULTY

Faculty members too are positively influenced by their participation and leadership in VDC courses. They have the opportunity to renew the connections between research, education and the local community that their academic institution serves, and to increase enthusiasm for their work.

It's been really rewarding to be part of the VDC; I've met such interesting people and seen a different side of computer science. I've grown as a professor and a person through this work. I've learned more than I ever imagined.

[The] students' dedication to the projects was something I'd never seen before in the math-based computer science classes I usually teach... [I've] seen a different side of computer science ..."

It's thrilling for me as an instructor, too – I don't get the chance to teach an interdisciplinary class like 'Designing Technology for Girls and Women' very often.

It's so easy to get so focused on my work. I forget to look at different aspects of technology ... [It's] helped me refresh my perspective.

The VDC course, and in particular, the Innovation Workshop, introduces innovative pedagogical strategies and environments for respectful student interactions into other academic courses for which faculty are responsible. These courses in turn attract a greater diversity of students. The association of faculty members with VDC courses also presents opportunities for new areas of scholarly research and personal recognition.

BENEFITS FOR THE CULTURE OF EDUCATION

The strengthened commitment of women undergraduate students in engineering and computer science bodes well for their retention in these fields and for increasing diversity in academia and the technical professions.

As an outcome of the VDC, the potential for educational reform within post-secondary institutions is being explored with the introduction of new courses on 'technology and society'. As examples,

- The course, Technology for Community, developed by Dr. Elizabeth Jessup, Associate Professor of Computer Science, is now a permanent part of the University of Colorado, Boulder curriculum.
- At Santa Clara University, Dr. Ruth Davis, Robert W. Peters Professor and Associate Dean for Undergraduate Studies, School of Engineering, received a National Science Foundation planning grant to pilot a program to redefine the undergraduate experience at SCU through the Community Learning Enabling Engineering Reform Initiative. This work builds on the institution's chartering work with the VDC.
- Dr. Alice M. Agogino, Roscoe and Elizabeth Hughes Professor of Mechanical Engineering, UC Berkeley, has initiated a new service learning course, Designing Technology for Girls and Women, which is being offered as a technology literacy course with students from all disciplines across the campus.

There is also an injection of new 'third party energy' in the academic setting as a result of students and faculty sharing successes and lessons learned between schools. The VDC Conference in particular is fostering this notion of 'collaberation', a leveraging combination of collaboration and competition.

"I know from indirect feedback that there's a kind of nudging effect, an excitement at the possibilities for learning across institutions, an eagerness to learn what others who are embedded in different university contexts are doing. To me, this is a rich and vital part of the VDC." (Jim Koch, founding Director of the Center for Science, Technology and Society at Santa Clara University)

Benefits for Sponsors

Access to talented future employees

Opportunity for increasing diversity in the workplace

Innovative product ideas

Increased positive visibility in external communities and to the general public

Access to new strategic partnerships



These young women of technology are drawing the relevance back into the field and redefining why and how engineering is done.

**GLORIA MONTANO
VDC DIRECTOR**

Future Directions

The Institute is building on the positive outcomes of the first five years of the VDC. An immediate priority is to strengthen current initiatives at existing sites by assisting faculty in moving their successful programs from the margins into the mainstream of their institutions.

At the same time, the Institute will expand VDC impact by extending the network to more schools within the U.S. and internationally. Evaluation, feedback and reflection from the first five years of the VDC point to concrete ways to deliver enhancements to increase impact and facilitate expansion.

INNOVATION WORKSHOP DISSEMINATION

The Innovation Workshop is an incremental yet powerful enhancement for existing design courses in universities and colleges. The Institute will package and promote the Innovation Workshop for team applications wherever diverse perspectives are to be elicited and equally valued, especially where the gap between participants is great.

The Workshop is a process that will benefit from and accompany the proposed educational enhancements described in the next section.

EDUCATIONAL MODULES

VDC Leadership Team faculty members at the University of Arizona, Tucson, have identified innovative curriculum materials, resources and processes to more effectively engage students in technology. They describe modular materials that can be packaged, promoted and delivered to other faculty who are teaching design courses. To work actively with women's priorities and focus on community organizations requires "careful attention to a new set of requirements about process in what matters, who matters, and how to ensure participation."

Proposed modules incorporate materials in multiple media to support active learning in and out of the classroom. Topics include:

- Strategies for working with community organizations and gathering design requirements,
- Creating environments for listening and thinking with diverse populations,
- Developing strong teamwork in women-dominated settings,
- Application of user-centered design and user testing in diverse community projects,
- Organizing for project management with community partners,
- Incorporating sustainable engineering and global impact in design projects,
- Ensuring attention to universal design/accessibility principles in design,
- Understanding the roles of gender in requirements, design solutions, testing, and engineering organizations, and
- Developing strong communication skills for women.



COLLABORATION BETWEEN SITES

An immediate action for strengthening the VDC is to look for meaningful trends, universal ideas, and defining themes to heighten collaboration between the sites.

Students asked for even more collaboration with other sites during the year through the Institute’s website, email distribution lists, and newsletter updates. Also high on the list was a call for promotional material to help contextualize each site’s work with the larger VDC network. Students felt this material would greatly help them effectively share the results and experiences of other VDC sites with family, friends, and community partners during their work.

CONFERENCE DEVELOPMENT

Several future actions build on the positive results of the annual VDC Conference:

- Externally promote the results from past VDC Conferences.
- Expand participation in the Conference beyond the VDC while still respecting participant appreciation for the intimacy of a small event, perhaps through regional conferences.
- Expand the program content, aligning with a focus around education reform, sustainability, or specific product theme areas.

MENTOR COACHES

Service-learning and community-based classes place extra supervisory requirements on faculty who are already fully involved in teaching technical skills. This additional load will be shouldered through the development of a pool of mentor coaches. These coaches will work with undergraduate student project teams lacking the management experience to deliver high quality solutions on time and meet client expectations. The success of the teams will be more assured under good supervision.

The pool of mentor coaches will draw from experienced women engineers and engineering managers temporarily out of the workforce, as well as graduate students. By screening potential coaches and providing a defined level of training consistent with the culture of the VDC, an established level of ability is developed. Direct access to experienced technical women provides students with positive role models. This is also an opportunity to ignite an interest in academic careers among the mentors who are a population at high risk of permanently leaving technical professions. Graduate student coaches will benefit from the development of their teaching and management skills.

EVALUATION AND ASSESSMENT

The Innovation Workshop is the unique and important element of the VDC, designed to complement existing academic courses. Current surveys and continuing anecdotal information suggest significant, longer term effects on students participating in the Innovation Workshops and VDC course, specifically increased motivation contributing to the retention of engineering and computer science students, especially among women.

One proposed study will evaluate the Workshop element of the VDC program at several campus sites in the VDC network to assess the effectiveness of the Workshop pedagogical methods in contributing to gender equity in engineering classrooms.

There is also potential for more in-depth study in the change in community attitudes toward technology, and to identify the education and career paths of the early cohort of VDC students.



From Enrichment to Reform: A Pathway to Systemic Change

EDUCATIONAL REFORM

Studies and local experiences show that how well an educator can relate course material to real life applications has a direct impact on students' motivation and commitment to enter and complete studies in computer science and engineering. Unfortunately, most of the current course materials and curricula fail to adequately represent female perspectives, realities or priorities.

Furthermore, while most engineering and computer science programs are effective at training and educating students on problem solving techniques, insufficient attention is focused on how to determine if the ones that are chosen to be solved are really the most appropriate problems to tackle first. Given the long term expectation of shortages in the domestic technical workforce, it benefits the nation to apply the available technical workforce as wisely as possible.

The technical professions themselves are also recognizing the necessity of transforming education. In *The Engineer of 2020: Visions of Engineering in the New Century*, recommendations refer to connection to societal needs, inclusion and interdisciplinary benefits.¹⁵

We need to undergo fundamental changes in the "what", "how" and "who" we teach if we are to meet the needs of 2020. (William A. Wulf, President, National Academy of Engineering)

The VDC advocates that engineering and computer science curricula be adjusted to include educating students on how to better determine which problems are most important to address first, using the greater positive benefit to society and the overall quality of human life as primary motivators. By focusing on women, we tap a population that naturally spans all dimensions of diversity and will share benefits to the broader community.

The pathway to achieving these far-reaching goals requires the bold reform of technical education by the **mainstreaming** of community-based learning, progressive teaching methodologies, and inter- and multi-disciplinary studies. We need to learn from, transform, and shift innovative initiatives such as the VDC to the heart of the academic undergraduate experience. Our destination on that journey is the 'fourth tier'.



Development Stages

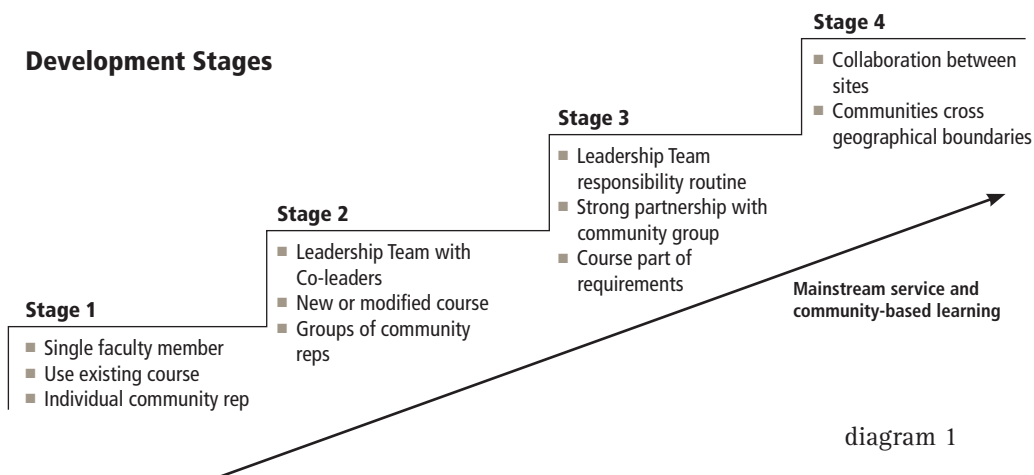


diagram 1

ADVANCING TO THE FOURTH TIER

Where are we along that journey? In the VDC, we measure progress towards systemic change as illustrated in the diagram 1. Today, academic institutions in the VDC span Stage 1 through Stage 3. A clear long-term goal, summarized as Stage 4, results in collaborations across institutional and geographical boundaries. That stage reflects that VDC processes are embedded in academic settings and that faculty participation is concretely recognized. We will move technical education emphasizing societal benefit from the margins into the mainstream.

CULTURAL CHANGE

In the epilogue of their landmark book **Unlocking the Clubhouse – Women in Computing**, Jane Margolis and Allan Fisher quote feminist theorist Carol Gilligan:

To bring women in is not just to rectify an inequity ... it means to change the whole conversation.

They go on to describe the VDC as one effort to effect real change.

This is more than just a different conversation with different participants. It is also formative in that it moves beyond talk into action and physical reality. This conversation and many more like it are needed to build a broader vision of computing ...¹⁶

In its report, **Technically Speaking**, the National Academy of Engineering clearly articulates the state of the relationship between technology and the general public.

Technology has become so common and important in our daily lives that we often do not even see it. As a consequence, most Americans have become less interested in or even capable of looking below the surface of technology. Indeed, most modern technologies are designed so users do not have to know how they work in order to operate them.¹⁷

In the VDC, we want our work to influence the academic and business worlds and promote full participation, true diversity, authentic collaboration, and the development of need-based technology. We believe that such shifts in the conversation are essential elements to transforming the relationship between the general public, especially women, and technology. This transformation will introduce cultural changes that will finally allow women to have a significant impact on technology. With that kind of impact, women will then be able to have a significant influence on how technology brings greater positive benefit to the world.

Final Words from Anita Borg

Imagine a world in which IT [Information Technology] was used to its highest potential, being an engine for an efficient, ecological economy and providing new opportunities for more people based on more available knowledge. Imagine a political system based on open access to information, better education, more communication, and equal participation. Imagine connecting people around the world in the spirit of positive internationalism, where social goals such as universal literacy, basic education, and health care are achieved. Imagine using IT to enhance the family and community in ways that each desires and needs.

In this century, we have the responsibility to learn, be involved in, and have an opinion about technology, and to ensure that women and girls are actively involved in creating the future.¹⁸



COMMUNITY GROUPS INVOLVED WITH VDC SITES FROM 1999–2004

Purdue University (1999)

Middle school girls including from:
Lafayette Urban Ministry
Girl Scouts, 4 H, area schools
Purdue Univ. Computer Science Department

Santa Clara University (1999)

HomeSafe
Westwood Elementary School

Texas A&M (1999)

Center for Underprivileged Children leaders
Seniors' Center members
High School teachers, students

Smith College (2000)

Elementary and middle school children including from:
Bridge St. Elementary School
Smith College Campus School
Holyoke Children's Museum



University of Arizona - Tucson (2000)

Goodwill Industries
Project for Homemakers in Arizona Seeking Employment
Pima Community College Adult Education
Tucson Community Food Bank
Muscular Dystrophy Association
Way of the Heart
Platicamos Salud
Nogales School District
Santa Cruz County
University of Arizona College of Public Health
University of Arizona Rural Health Program
Southeast Arizona Medical Center

University of Colorado - Boulder (2000)

Digital Water Education Library
Thorne Ecological Institute
Boulder Senior Center
Boulder Valley School District
Build Boulder
University Hill Neighborhood Ass'n
Community Foundation
CU GLBT Resource Center
CU Conference on World Affairs
Sojourner Middle School
Self Build Archive
Elementary Spanish Program
Twinkle Network
Congressional Bill Sponsorship Project
Berthoud Main Street
Feet Wet Project

University of California - Berkeley (2001)

Disabled Community members
Girls, Inc.
Exploratorium
Lawrence Hall of Science
Chabot Observatory

University of Washington - Seattle (2001)

CASA Latina
UW Thai Language Program
Seattle Girls' School
Central District (Seattle)
African American Academy
Technology Access Foundation
UW ADVANCE

University of Texas - El Paso (2002)

United Blood Services
El Paso area middle school girls
CandleLighters
Project Arriba / Region 19

Notre Dame de Namur (2004)

Peninsula Conflict Resolution Center

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** Commission on Professionals in Science and Technology. STEM Workforce Data Project No. 2. Women in Science and Technology: the Sisyphian Challenge of Change. Data from U.S. Bureau of Labor Statistics. http://www.cpst.org/STEM_Report.cfm
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THE VIRTUAL DEVELOPMENT CENTER

The VDC Network

Purdue University
(epics.ecn.purdue.edu/abiwt)

Santa Clara University
(www.scu.edu/engineering/vdc)

Smith College
(www.science.smith.edu/Engin/support_partners.php)

Texas A&M University

University of Arizona, Tucson
(www.engr.arizona.edu/vdc)

University of Colorado, Boulder
(grackle.colorado.edu:4242/VDC)

University of California, Berkeley
(www.eecs.berkeley.edu/Programs/VDC.html)

University of Texas at El Paso
(www.ece.utep.edu/research/webvdc)

University of Washington, Seattle
(courses.washington.edu/engr100h)

Notre Dame de Namur University
(www.ndnu.edu/sciences/center/vdc)

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