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# Diversity in Computing: A Means or a Target?

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## Introduction

This column presents a different perspective on the ongoing discussion about women's underrepresentation in computing. The essay asserts that it is in the interest of the computing world, rather than in the interest of any specific underrepresented group in this community, to enhance diversity in general, and gender diversity in particular. This claim is established by showing the benefit that organizations, firms and communities derive from enhancing and embracing diversity. Therefore, as mentioned above, lack of diversity should not be the concern of underrepresented groups; rather, it is in the interest of the computing world to be more inclusive. In other words, diversity should be conceived as a means, rather than as the target itself.

Indeed, the advantages of diversity have already been acknowledged. For example, Deloitte and Touche's *Diversity & Inclusion Initiative* declares the wish to gain a "competitive advantage in today's marketplace":

> *We strive to attract and retain professionals of all backgrounds and experiences at Deloitte & Touche USA LLP and to provide an inclusive culture. This allows us to offer clients the best solutions and help our people realize their greatest potentials*.
>
> (See http://www.deloitte.com/dtt/section_node/0,1042,sid%253D2270,00.html)

As can be easily seen, the wish for diversity stems from the recognition that diversity might improve the services the company provides; that is, diversity is conceived as a means for the benefit of all.

In the context of computing, according to this perspective, I suggest abandoning the two traditional approaches usually advocated towards the underrepresentation of

women in computing. These approaches claim either that women must adjust to technology and science or, conversely, that technology and science should be adjusted to suit women. According to the first approach, women's adjustment to technology and to the computing world should be supported and in this spirit, associations have been established to support women in this adjustment. Activities resulting from the second approach, which attempts to adjust technology and computing to women, advocate, for example, women-friendly computer science and software engineering undergraduate curricula. As is well known, however, these common approaches have not achieved their targets so far; the evidence is clear – women remain underrepresented in scientific and engineering fields in general, and in computer science and software engineering in particular.

The approach presented here asserts that there is no need to adjust women and computing to each other, since the *fit already exists*. This approach strives to replace the two perspectives presented in the previous paragraph by suggesting the creation of a culture that enhances diversity (as a means), not only for the benefit of women, but *for the benefit of the entire computing community* (the target).

In what follows, I will first establish two working assumptions: The first claims that the women-computing fit exists, and the second states that diversity benefits organizations, communities and firms that welcome it. Then, using three case studies from the computing world, I will illustrate how, in different organizational situations in which solutions for different kinds of problems were sought, successful solutions based on cultural change were strongly linked to the enhancement of diversity. These two parts of the essay constitute the basis for my assertion that, in general, diversity should be conceived as a means rather than as a target and that in the computing world, diversity is in the interest of the entire community, and, in particular, the underrepresentation of women in computing should not be the concern of women alone but, rather, that of the entire community.

## Working assumptions

**Working Assumption 1: The women-technology/science fit exists.** This working assumption can be easily derived, first, from the vast information about the success of female pupils in single-gender math and sciences classes (For example, see http://www.education-world.com/a_curr/curr215.shtml and note that success

increased for both genders), and second, from the fact that in many cultures no difference is observed between genders in terms of their participation in computing (see for example [1]).

**Working Assumption 2: Diversity benefits organizations that welcome it.** Even an intuitive examination of this working assumption reveals that it is logical. First, if a system allows for diversity, diversity enables to select the best and most professional and high-quality people from a larger pool. Second, when a diverse organization faces complex situations (such as those that characterize the computing world), it may gain many different opinions and possible solutions to select from. And third, diversity inspires people not to be trapped in their perceptions, but rather encourages them to be open to new ideas, opinions and viewpoints.

The fact that diversity, regardless of how it is expressed, benefits those communities that welcome and foster it is supported by more established evidence as well. For example, in his 2002 book, *The Rise of the Creative Class,* Richard Florida [4] shows a correlation between the fact that a community welcomes diversity (reflected by a Diversity Rank) and its attractiveness to members of the creative class – a class that adds benefit to regions in which its members reside, so that these regions benefit from their attractiveness to members of the creative class. San Francisco, for example, ranks first on the Creativity Index, with 34.8% of the city's population defined as creative workers, and is the highest also on the Diversity Rank; San Diego ranks third on the Creativity Index (32.1% creative workers), and third on the Diversity Rank (For more details about Florida's research see http://www.creativeclass.org/).

Other examples for benefits that organizations might gain from the enhancement of a culture that welcomes diversity are Toyota's 21st Century Diversity Strategy (see http://www.toyota.com/about/diversity/21stcenturyplan.pdf) and [9].

## Case studies

To illustrate my perspective, I will use the following pattern for three case studies. First, I present a problem. Then, I present a successful solution that was applied to the problem, solved the problem and established a cultural change in the said case. Finally, I describe the outcome, highlighting two facts: first, I show that the solution has solved the said problem for the *benefit of all*; and second, I illustrate how the solution enhanced diversity.

**Case study 1: Agile software development**

*Problem*: We are all familiar with the characteristic problems of software projects: customer dissatisfaction, bugs, failure to meet deadlines and more.

*Solution*: As a response to these problems, agile software development emerged in the mid 1990s. The agile approach reflects the notion that software development environments should support communication and information sharing (between all project stakeholders), as well as heavy testing, development in short releases and improving product quality, by encouraging a sustainable work pace and the notion of whole team.

The Agile Manifesto (see Table 1) reveals that, among other changes it introduces into the software development world, the agile approach is about cultural change, which encourages new and different kinds of behaviors in software development environments and welcomes a new kind of people to join the community of software developers. Agile software development has become more and more prevalent and it is now accepted as mainstream in the software development industry and is currently being applied as the development paradigm by about 20% of companies in North America and Europe (see http://www.versionone.com/pdf/AgileMyths_BetterSoftware.pdf.

**Table 1. The Agile Manifesto** (Source: http://agilemanifesto.org/)

| **Manifesto for Agile Software Development** |
|---|
| We are uncovering better ways of developing<br>software by doing it and helping others do it.<br>Through this work we have come to value:<br>Individuals and interactions over *processes and tools*<br>Working software over *comprehensive documentation*<br>Customer collaboration over *contract negotiation*<br>Responding to change over *following a plan*.<br>That is, while there is value in the items on<br>the right, we value the items on the left more. |

*Outcome*: Though the agile approach emerged originally in order to solve problems in software development processes that have nothing to do with diversity, as it turns out and as is illustrated in what follows, the agile paradigm for software development not only improves product quality and customer satisfaction, but also has the potential to enhance diversity.

First, it is acknowledged that agile software development indeed improves software development processes. Much data show that software projects developed using agile software development processes not only increase developers' and customers' satisfaction, but also lead to cost reductions of 5-7% on average and to 25-50% reductions in time to market [8]. In other words, agile software development benefits all.

Second, I examine the potential of the agile approach to increase diversity in general, and gender diversity in particular. In [6] we showed how gender diversity is enhanced in agile software development environments. This was illustrated by data gathered from comprehensive research that took place in the framework of a course on operating system projects, offered by the Computer Science Department at the Technion – Israel Institute of Technology. The agile method has been used in this course, since the 2002 summer semester, by teams of 10-12 students, each team guided by an academic coach, working in a studio-oriented environment. More details about the course are presented in [3].

The communication aspect of agile teams was observed by examining the behavior of 294 students, who worked according to the agile method for 8 semesters in 27 different groups. This examination revealed that male and female students are equally communicative. Specifically, when communicative behavior was measured using the electronic forum used by the students for project management and for their personal reflections, usually written after each weekly meeting, we found that the proportion of forum messages sent by male students and by female students (77.2% to 22.8%, respectively) equals the proportions of the two genders in the course itself (77.6% to 22.4%, respectively).

As it turns out, the emergence of diversity in agile software development environments is not limited to gender diversity and it is acknowledged also with respect to the wider interpretation of the concept of diversity, as described by Beck

and Andres [2], who include diversity as a core principle of Extreme Programming (one of the leading agile software development methods), stating that: "Teams need to bring together a variety of skills, attitudes, and perspectives to see problems and pitfalls, to think of multiple ways to solve problems, and to implement the solutions. Teams need diversity" (p. 29).

**Case study 2: School of Computer Science at Carnegie Mellon University**

*Problem:* Prior to 1999, admissions policies of the School of Computer Science (SCS) at Carnegie Mellon University (CMU) emphasized programming experience. It was observed, however, that the amount of prior programming experience did not affect graduation rates. Furthermore, as a result of this emphasis on previous programming experience, the body of students was homogeneous and *unbalanced* in terms of gender and range of student personalities. From personal communications with faculty members of the school, I learned that this unbalanced and homogeneous body of students was not consistent with the school's orientation, which welcomes diversity, and with the school's structure, which is characterized, among other things, by diverse and wide-ranging research areas. Naturally, if the SCS at CMU wished to capture this atmosphere, it could not welcome only one specific kind of students, who are associated with only one aspect of the field.

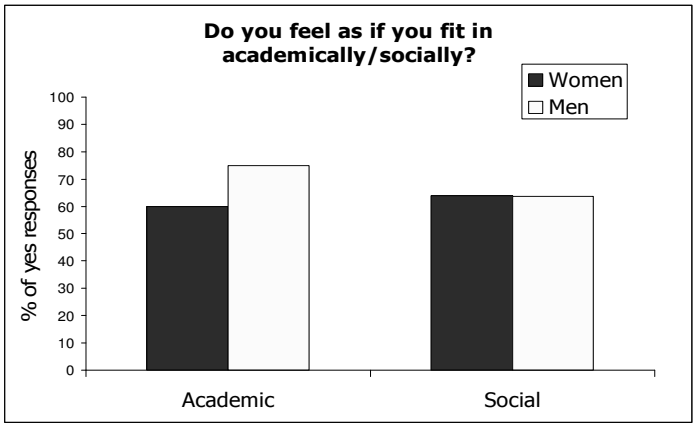
*Solution*: As a response to this situation, by the end of 1999 new admissions criteria were set, which de-emphasized prior programming experience and placed more emphasis on breadth of individual interests and strengths, such as leadership orientation. It is important to emphasize that the academic criteria were not reduced, the curriculum was *not* adapted to become “female-friendly”; rather, it continues to be one of the most rigorous computer science programs in the United States.

*Outcome*: This change in admissions criteria naturally had an impact on student diversity. In general, the number of students with broad interests, both *men and women*, increased. In particular, with respect to gender, women's presence in the undergraduate CS population increased from 7% in the mid 1990s to 36% by 2001, maintaining its critical female mass till today.

The change, however, was not limited to diversity in the student body, but in addition, has influenced the culture of computing, which has changed in such a way that both men and women can succeed; in short – *the change benefited all.* Figure 1, which

shows that both genders fit in and feel comfortable with the new culture that has emerged [5], is only one illustrative example of this claim.

**Figure 1. Student's Sense of Fitting In after Freshmen Year [5]**




This openness towards diversity was expressed also by the establishment of the Women@SCS organization that supports diversity and maintains the cultural change**.** It is important to note that Women@SCS is not a "handholding" support group for female students and that men also participate in the activities organized by this organization. One such activity is the SCS Day, which was inspired and initiated by Women@SCS, and whose mission is presented as follows:

> *SCS Day is a celebration of the diversity in the School of Computer Science at Carnegie Mellon University. SCS Day will be a dynamic event including workshops, exhibits, games, and a talent show. All the members of the SCS community - undergraduate and graduate students, faculty, staff and alumni - are invited to display their talents and share their skills in a fun and relaxed atmosphere*. (For more details look at http://www.cs.cmu.edu/~scsday/)

The above-described cultural change, which emerged as a response to the increase in diversity, is not detached from the overall Carnegie Mellon atmosphere, as it is reflected, for example, in CMU President Jared L. Cohon's Statement on Diversity:

> *I want Carnegie Mellon to be a place that celebrates these diversities rather than merely tolerating them, because being a more diverse institution will make us a better institution. In the classroom, studio, laboratory, office and dormitory, a multitude of experiences, perspectives and beliefs will enrich all that we do.* (Source: http://hr.web.cmu.edu/drg/overview/statement.html)

Once again, we can see that diversity does not serve as a target but as a means to improve university performance.

**Case study 3: Siemens and global software development**

This example is taken from the keynote lecture presented by Reinhold Achatz, Vice President Software and Engineering of Siemens Corporate Technology, entitled "Optimization of Software Development", at the ICSE 2006 conference that took place in Shanghai in May 2006 (See: http://www.isr.uci.edu/icse-06/program/keynotes/achatz.html).

*Problem*: Siemens looked for an opportunity to enter into new markets.

*Solution*: Siemens used diversity in general, and, in particular, the culture of the Eastern world.

*Outcome*: Mr. Achatz presented an example of a product that was developed in Siemens' new development center in China, had a simple design and was easily introduced into the worldwide market.

In the context of this essay, the essence of this example is not to take advantage of the cheap labor force available in the Eastern world, but rather to perceive the collaboration between the Western and Eastern worlds and the inherent diversity in such situations, as a means for improving software development processes, as an opportunity for excellence and as a source of creativity (the targets).

## Conclusion

Let us try to examine why diversity is so important in the computing world and why it is so relevant to make a claim for diversity in the community of computing. One answer, I suggest, refers to the fact that we are dealing with a field that is characterized by an ongoing change process. Indeed, in his book *Darwin Machines and the Nature of Knowledge*, Plotkin [7] presents diversity as one mechanism for coping with the uncertainty introduced by changes. This strategy belongs to the set of solutions that advocate the message "if you can't beat it, join it", i.e., change the infrastructure so that it can change with and match the changing features of the world. Indeed, this is exactly the nature of the computing world, and therefore, it is not surprising that diversity might solve some of the problems associated with the computing world.

To conclude, since, as has been illustrated, diversity benefits companies, organizations and communities that welcome it, diversity should be conceived as a means rather than as a target. Accordingly, cultural change that supports diversity is a possible solution for problems facing our community. In practice, when solutions to different kinds of social and cultural problems are examined, in and beyond the computing world, it is worth checking their potential to increase diversity.

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