

Empower Gender Diversity with Agile Software Development

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INTRODUCTION

Gender issues have recently been discussed extensively with respect to the computing fields (cf. Camp, 2002; Margolis and Fisher, 2002; Bair and McGrathe-Cohon, 2005). One of the discussed issues is the “shrinking pipeline” phenomenon (Camp, 1997). Camp shows how, in addition to the shrinking of the pipeline upon transition from high school to graduate school, the pipeline has been shrinking also at the bachelor degree level since 1983. She argues that since the number of women at the bachelor’s level affects the number of women at levels higher in the pipeline and in the job market, this phenomenon is of great concern (p. 104).

The shrinking pipeline is explained in various ways. Among other explanations, the image of the field as requiring long hours of programming is a dominant one. Here is an illustrative case. The April 3rd, 2003 edition of the Pittsburgh Post-Gazette Business News addressed the question of why more women are not involved in the tech fields¹. This question was discussed by a panel, assembled by the Pittsburgh Technology Council a week before the article was published, which included some of the region's most successful women. Among other arguments, Robbin Steif, Chief Financial Officer of Maya Design, said: “It might be an issue of self-selection – women might not be risk takers.” And she added: “It might also have something to do with the work/family issue, because entrepreneurs work way more than 40 hours per week.”

This chapter focuses on software development teams using one of the agile software development methods. High quality of working software is the primary measure of progress; however, agile software development processes promote in addition sustainable pace of all the individuals (sponsors, developers, and users) involved in the software development process², welcome requirement changes even in late stages of the development, and favor face-to-face communication. Based on

¹ The Post-Gazette Business News <http://www.post-gazette.com/pg/03093/171152.stm> .

² From the agile manifesto at <http://agilemanifesto.org/> and principles at <http://agilemanifesto.org/principles.html> .

our observations of agile software teams both in the academia and in industry, we claim that such software development frameworks enable women gaining new and better positions in the hi-tech industry in general and in software development teams in particular. We view this chapter as an example of how diversity can be achieved in software teams. In a current research we explore other dimensions by which diversity can be achieved in software teams, such as minorities and nationalities.

The perspective and data that presented in this article are part of our research about human aspects of software engineering and specifically our comprehensive research about cognitive and organizational aspects of agile software development methods both in the industry and the academia (Hazzan and Dubinsky, 2003A, 2003B; Tomayko and Hazzan, 2004; Dubinsky and Hazzan, 2004; Dubinsky, Talby, Hazzan and Keren, submitted 2005).

B A C K G R O U N D

The aforementioned image of the hi-tech industry in general and the software industry in particular was developed mainly during the dot-com bubble era. In those days, the media painted a picture of the dot-com world as a sleep-on-the-office-floor and sacrifice-your-family-time way of life. This image might tend to discourage women from entering the computing field and can partially explain the significant decrease in the female population of computer science students over the past twenty years, from 35% in the 1980's to a 15-20% level at the beginning of the millennium (Camp, 1997; Davies and Camp, 2000).

The above picture accompanied data that indicate that the software industry suffers from many typical problems. For example, software projects fail to be delivered on time, exceed their budget, and do not comply with the requirements put forth by the customer (see for example, Fairley and Willshire, 2003). Furthermore, according to the National Institute of Standards and Technology (NIST), New Release of June 28, 2002, "Software bugs, or errors, are so prevalent and so detrimental that they cost the U.S. economy an estimated \$59.5 billion annually, or about 0.6 percent of the gross domestic product."

The Agile Approach and Extreme Programming

During the 1990's, the agile approach of software development started to emerge as a response to the problems of the software industry. Specifically, the agile software development approach, composed of seven methods, formalized development frameworks which aimed at overcoming these characteristic problems of software projects (Highsmith, 2002).

Extreme Programming is accepted as the most commonly used agile software development method. It is based on four values expressed by twelve practices, which support and complement each other. The four Extreme Programming values are: communication, simplicity, feedback, and courage. The twelve practices, as originally envisioned by Kent Beck (2000) are: the planning game, pair programming, refactoring, simple design, continuous integration, test-driven development, collective ownership, coding standards, short releases, metaphor, sustainable pace, and on-site customer³.

Extreme Programming values and practices were selected based on the accumulative insight derived from extensive experience in the software industry, and the recognition that quality software systems should, perhaps, be developed by adhering to very specific and detailed practices. Rather than stating principles and development phases that can be interpreted and implemented differently by different software teams, the Extreme Programming practices outline a very detailed procedure for the actual development of software systems.

Since Extreme Programming is the most accepted agile software development method, when we assimilate it with a specific software development team, we adopt its values and practices as a basic and, if necessarily, adjust them in the spirit of the agile approach according to the teams' needs. In this chapter, we refer to the adjusted Extreme Programming method as the *agile method*.

Women's Management Style

Women's style of management is based on sharing power, on inclusion, consultation, consensus, and collaboration. Women work interactively and swap information more freely than men do. Women managers encourage their employees by listening to, supporting, and encouraging them. (Fisher, 1999, p. 32).

Recent research studies have identified several characteristics attributed to women's management style. Here are some examples (italics added by authors).

- ◇ “Women's management style is more equal and collaborative, often described as 'transformational', in contrast to the traditional 'transactional' style preferred by men who rely on power position and formal authority.” (Vinnicombe and Singh, 2002).

³ In the second edition of his book (Beck with Andres, 2005), the value of respect is added and the practices have been slightly changed.

- ◇ “Recent research indicates women's management style, which is centered on communication and building positive relationships, is well suited to the leadership paradigm of the 90's.” (Peters, 2003).
- ◇ “The women's management style builds very much on participation by the employees and mutual trust, and they become very disappointed if the employees do not live up to that trust.” (Kjeldsen and Nielsen, 2000).

Needless to say, these attributes are compatible with any good management style; however, as the above quotes indicate, research attributes them to women.

Data Resources

The data presented in this chapter is gathered from two resources. The first is a comprehensive research that takes place at the Computer Science Department of the Technion – Israel institute of technology, in a project-based operating-systems course. In this course the agile method has been used since the Summer 2002 semester by teams of 10-12 students, each team guided by an academic coach. Each student is a developer and, in addition, has a management role that deals with a specific aspect of the software project management. In other words, all students are involved in a specific managerial aspect in addition to their role as software developers (the description of all roles is presented in Dubinsky and Hazzan, 2004). A web-based tool is used for the project management and for students' personal reflections written almost after each weekly meeting. The data gathered in this course represents 27 projects developed by the agile method by about 300 students. We would like to highlight the fact that diversity in these teams was expressed not only in terms of gender. For example, one of these teams consisted of male and female, Arab and Jewish, religious and non-religious students, new immigrants and Israeli natives students. It is felt very clearly how this mix influenced negotiation, discussion and cooperation work style. As has been mentioned before, we further explore this phenomenon.

The second resource for data is a long term research (started a year and a half ago) in the Israeli Air Force software-unit. In this case we guide a software team in the assimilation of the agile method and consult during its implementation process (Dubinsky, Talby, Hazzan and Keren, in press, 2005). The data in this case represents 1 project with 15 teammates involved.

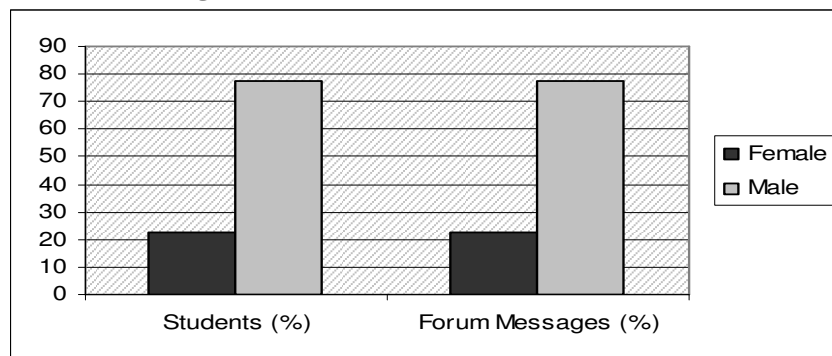
M A I N T H R U S T O F T H E C H A P T E R

The agile approach reflects the notion that development environments should support communication and information sharing, in addition to heavy testing, short releases, customer satisfaction, and sustainable work-pace of all individuals involved. The main characteristics of women's management style as quoted above are collaboration and sharing, communication, and trustful

and positive working relationships. In what follows, the suitability of the agile approach to the characteristics of women's management style is presented and is accompanied by data gathered from the above resources. Specifically, we examine the above-mentioned characteristics of women's management style in light of the agile principles that support them. Based on this analysis, it is argued that the agile method has the potential to be very well suited to women's management style.

Communication: Communication is vital for an agile team in order to be effective and to produce quality working software. A communicative-oriented examination of 294 students' behavior, who worked according to the agile method during 8 semesters in 27 different groups, reveals that females are equally communicative. Specifically, the communicative behavior is measured using the electronic forum that the students use. Figure 1 illustrates this observation presenting the percentages of the number of students – 228 males (77.6%) and 66 females (22.4%), and the percentage of the number of forum messages each student sent – 4702 messages by males (77.2%) and 1391 by females (22.8%).

Figure 1: Communicative behavior



This observation of female students who are equally communicative reoccurs each semester. Figure 2 presents the two most not-equally semesters: in Figure 2a the female students were less communicative; in Figure 2b the female students were more communicative than the male students. These two figure illustrate that even in these not-equally cases the difference is expressed in small number of percentages. Specifically, in the semester represented by Figure (2a) the percentage of female students was 42.9% and their percentage of forum messages was 35.4%; in the semester represented by Figure (2b) the percentage of female students was 37.5% and the percentage of their forum messages was 41.5%. Due to space limitations we are unable to present examples of messages and their analysis. However, based on a preliminary analysis of such messages, as well as based on the data presented in this section, we may conclude that female students feel comfortable with the agile principle of communication.

Figure 2: Communicative behavior in two specific semesters

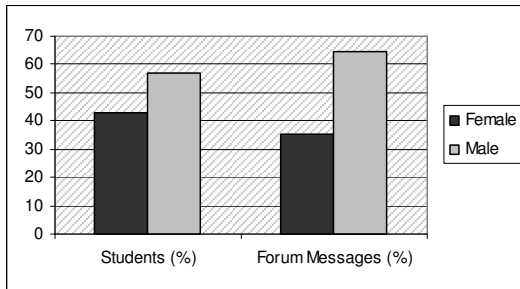


Figure 2a

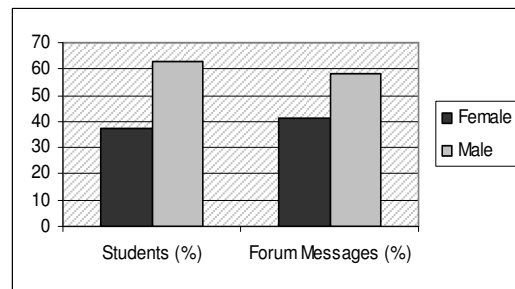


Figure 2b

Collaboration and sharing: Collaboration and sharing in agile software development environments are expressed by some of the agile principles and practices. "Develop together", and specifically pair programming, is already found as one of the practices that can expand the shrinking pipeline (Werner et al.,2005).

We illustrate the fitness of this aspect of the agile method to female students by data taken from one semester. In this semester 3 groups of students – all together 32 students, 20 males and 12 females – were guided by 3 different academic coaches and developed 3 different products. Specifically, we examine one answer to one of the last week reflection which asked whether the work in a large team of students contributed to the software development process, and if yes - how.

Out of 20 males, only 11 answer the question using all together 469 words (average 42.6, median 36). Out of 12 females, 9 answer the question using all together 965 words (average 107.2, median 110). We present the word count data since it delivers a clear message – the female students found the question intriguing.

An in-depth examination reveals additional aspects. Looking for phrases that indicate collaboration, we found that 8 males out of 11 and 7 females out of 9 used collaboration phrases. Here are several examples of collaborative phrases: "it was a great challenge to coordinate all teammates.."; "The experience...involves interpersonal relationship..."; "I think that everyone felt during the semester that he has a backup in any case of a problem". Looking for phrases that indicate sharing, 1 male out of 11 and 3 females out of 9 use phrases that indicate sharing. Interestingly, all the sharing phrases referred to situations in which other teammates shared information and ideas with the student who answered. For example, "In this way you can learn more about other people ideas and solutions". As we can see females students feel comfortable with the agile principles of collaboration and sharing.

One of the obstacles of the implementation of the agile method in the industry addresses the inclusion of the software quality-assurance aspect into the general software teamwork, and by doing so to end the ongoing competition between developers and quality-assurance testers. In a previous

work (Dubinsky, Talby, Hazzan and Keren, in press, 2005) we present a set of agile metrics that were emerged during the first release. One of the metrics – *Product* – describes the size of the product by counting test points. The sharing event we would like to highlight here happened after three iterations when it became clear that test writing causes a bottleneck. Consequently, it was decided that at the beginning of the fourth iteration the main tester will teach the developers to write automatic test scenarios for the code they develop. Accordingly, during the fourth iteration she (the tester) taught the developers to write tests, and consequently wrote fewer tests by herself. The result was a sharp increase in product size during the fourth iteration when more and more developers started writing tests. We bring this story here since the accumulative experience with software development processes teaches that such knowledge sharing is very rare and therefore should be appreciated.

Trust and positive working relationships: These two features of women's management view point are grouped together since both, as is explained in what follows, convey a less competitive working environment. As mentioned previously, the agile method lays out specific practices that aim at guiding software developers during the process of developing quality software products. In our opinion, this attribute – the laying out of specific procedures – enhances trust and contributes to positive working relationships. More specifically, if specific procedures are adhered to, and if it is clear that by following such procedures no one is being taken advantage of by others since everyone is following the same procedures, the tendency toward competition is reduced and the element of trust is intensified. Further examination of this perspective is presented in Hazzan and Dubinsky, 2005.

So far, one can agree that it indeed seems that the agile method suits women's management frameworks very well. But, at the same time, one can claim that since the agile method is about software development, and since this industry requires a long work day, as previously explained women would tend not to join agile teams even though it may be compatible with their values. However, as it turns out, and as will be explained in what follows, even this barrier has been eliminated in agile software development environments.

One of the agile principles is sustainable pace. The rationale for keeping sustainable pace is that overworked programmers are unable to produce quality code. Since other agile principles, for example develop together, ensure productivity during the 40-hour week, agile programmers can work at a sustainable pace, be productive and produce quality code. The following data illustrates this productivity. Based on 31 Extreme Programming/Agile-methods early adopter projects, Reifer (2002) indicated a 25-50% reduction in time-to-market (p. 188). This evidence shows that the agile method inspires a productive and efficient working environment without working

long hours. The agile method delivers the message that quality and productivity can be achieved at a sustainable pace as long as the work hours are managed efficiently.

As it turns out, not only the agile method advocates the sustainable pace concept. For example, in their Software Project Management book, Hughes and Cotterell state: "There is good evidence that productivity and the quality of output goes down when more than about 40 hours a week are worked....Clearly, it is sometimes necessary to put in extra effort to overcome some temporary obstacle or to deal with emergency, but if overtime working becomes a way of life then there will be longer term problems." (p. 226). Indeed, in some cases this principle is presented as a general guideline or as a recommendation. At the same time, however, in agile development environments this concept is one of the core principles of the approach, and for an agile team, working in a sustainable pace is an integral part of the development framework.

F U T U R E T R E N D S

Encouraging potential female software developers to join the agile community requires an explanation of the development environment that this method inspires. This can be done in various educational frameworks. Indeed, following its origins in the industrial sector, agile methods have been explored in computer science and software engineering education, in educator symposiums instituted in conferences on agile methods (e.g., Eckstein, 2003) and in general computer science and software engineering education conferences (e.g., Bergin, Caristi, Dubinsky, Hazzan and Williams, 2004).

C O N C L U S I O N

Many associations undertake to promote women in the hi-tech industry. In most cases, these organizations seek ways to help women adjust to the prevalent work framework that characterizes this industry in general and software projects in particular. By presenting the agile software development environment in which women can feel comfortable without requiring any adjustment, this paper offers another way by which to recruit women into the software industry and in doing so to help partially expand the shrinking pipeline.

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