

WHAT BALANCE BETWEEN TECHNICAL STANDARDS, PROFESSIONAL STANDARDS,
AND PROFESSIONAL EDUCATION?

Last year the IEEE Computer Society and the ACM--the world's two largest organizations of computing practitioners (combined membership of more than 175,000)--formed a Joint Steering Committee for the Establishment of Software Engineering as a Profession. In so doing, they created an opportunity to study a profession coming into being--and, given the size and importance of the organizations involved, an opportunity not likely to be repeated soon. They also created an opportunity for scholars concerned with professions to make their research available to members of a profession at a crucial moment. We propose to seize that opportunity before it is lost.

The Joint Steering Committee established three task forces. One is to identify the body of knowledge and recommended practices that constitute the expertise of the new profession. A second is to define a curriculum for the training of members of the new profession (or, at least, set certain minimum educational standards). The third is to document and codify ethical and professional practices for members of the new profession. Each of these task forces is supposed to complete work by November 1995. Once the three report, they will be faced with the complex task of integrating ideas about what the technical knowledge of the profession is with what its professional and educational standards should be. What they decide may have substantial

effects on who can engage in software development, what is expected of them, and what they have a right to expect of their employers. The Joint Committee will, in effect, be faced with a practical version of one of the deepest problems in the theory of professionalism, determining how much of professionalism is (or should be) adherence to technical standards, how much having the appropriate training, and how much maintaining ethical standards.

We might illustrate the problem with an example. Bugs are a problem in software. They can be a serious problem, especially when the software runs an important business function like check writing or a piece of equipment that can cause great harm if it works improperly. No complex software is free of bugs. Testing can remove most, but testing is expensive. How much testing is enough? There are several ways to answer this question. One is for the software maker to adopt an organizational standard like the Capability Maturity Model (developed at Carnegie-Mellon's Software Engineering Institute [ref?]). That will, however, not necessarily provide a complete answer. There are various stages in the adoption of this model. Few companies are anywhere near the highest stage; and even the highest stage can't guarantee that software won't fail disastrously. Another way to answer the question is to have degree-granting institutions teach certain testing procedures as standard practice, assuring that the software developers they graduate will routinely use those procedures whether their companies think to require them or not. A third way is to make it part of being a (professional) software

developer that you will not sign off on a piece of software unless satisfied that it has been satisfactorily tested. Since a professional's being satisfied is not merely a matter of whether the test meets recommended technical standards (though it generally means at least that), such an ethical standard provides another way of protecting end-users. Such protection is important in a field, like software development, where change has been so fast that the technical standards have often been one or two steps behind the technology.

These three ways of answering the question of how much to test are, of course, not necessarily inconsistent. But there is a tension between them.

Because software development is such a large field, we propose to focus in this first exploratory research on only one part of the field, testing of software for safety and reliability. This sub-field corresponds to one of the working groups the task force on Software Engineering Ethics and Professional Practices has set up--as well as to a specialty in software development itself. We plan to attach ourselves to this working group (Reliability and Safety) and follow its process from stating the problem, to gathering ideas, to deliberation, to final recommendation, to dissolution. We hope this will lead to a larger project that picks up from there. We envisage a more open-ended sequel following in part, the working group's recommendations through the task force's deliberations, the deliberations of the Joint Committee, and so on until final

resolution (presumably, approval by the IEEE and ACM).

We have formed a research team consisting of three members and three consultants to carry out our initial research plan.

The members are Ilene Burnstein (CS, an expert on program testing), Michael Davis (CSEP, an expert on business ethics and codes of ethics), and Vivian Weil (CSEP, expert on engineering ethics). The ~~two~~ ^{three} consultants are Ullica Segerstrale (a social scientist working in science studies) and Barry Weiss (a lawyer versed in software liability issues).

Our research plan has four parts:

1. The working group on reliability and testing plans to do most of its work by e-mail, with only a few face-to-face meetings. We can therefore study its work in large part by reading its mail (which is supposed to be open to everyone). We would complement reading the mail by telephone interview from time to time a) to clear up matters e-mail leaves unclear and b) to make sure we aren't missing anything important (for example, the fruit of phone conversations or an informal chat at a conference). We would also participate in the few face-to-face meetings (whether these turn out to be at conferences or by teleconference).

2. The three members of the research team will meet monthly to analyze the process recorded in e-mail (and what we have learned by phone). We will be especially concerned to identify issues in need of further study. Some of this will simply be factual: for example, if an e-mail message refers to a

technical standard none of us recognizes, we would have to ask the most appropriate member of the research group to find out what it is and why it matters. Some of the further study will, however, be of a different order: for example, if an e-mail message claims that a certain testing procedure makes ethical standards of a certain sort unnecessary (without explaining that claim), we might want to ask the author for an explanation; and, if asking fails to generate a satisfactory one, may want to search the literature for a rationale in order to assess the claim. We will call upon the consultants as need for information or help in analyzing what we observe.

3. This discussion, shadowing the official working group, should help us develop our own understanding of the issues with which the working group is dealing, an independent expertise. and--given our research group's make-up--a perspective importantly different from the official working group's "insider" perspective. While we don't expect our view to be opposed to the (initial) views of the official working group, we do expect it to be different enough to be useful now and then, more because it will pick out or emphasizes considerations insiders may overlook or, at least, fail to appreciate, than because of any fundamental disagreement.

4. Once the working group completes its work, we will prepare a report summarizing and analyzing their work. The draft will be submitted to our consults for comment and suggestions.

We expect this research to have at least four outcomes:

1. The report of what we have observed during the year of our initial study. This should take the form a) of a report to the ACM and IEEE and b) of one or more research publications. We expect these research publications to contribute to at least three fields: the sociology of professions; professional ethics; and (perhaps) technical management.

2. Enough contacts, experience, and insight to propose a larger project to study the larger process of professionalizing software developers of which the working group activity is but a small part. Such a proposal would, of course, be contingent on the success of this project, but also on our making a determination, impossible to make now, about how much a larger project is likely to add to what we have already learned about the relation of individual responsibility, technical standards, and professional ethics.

3. Ideas for doing a better job of teaching testing to future software developers, whether trained in an engineering or computer science department. We expect these ideas to emerge from the continual contact between members of our interdisciplinary research team as they work together in the unusual circumstance of observing a new set of professional standards (and a new profession) coming into existence . We therefore view this project as, among other things, an aid to revising courses (or adding new ones) to better educate the next generation of software developers. Whatever useful ideas come out of our interdisciplinary meetings would, of course, also be

published in an appropriate place--and may, then, lead as well to new ideas for improving the continuing education of today's software developers.

4. Ideas the Joint Committee, its task force, or working group may find useful. Because the Joint Committee has adopted an open process, allowing everyone to read the committee debate (on e-mail) and to respond, we hope to participate in that debate as well as monitor it, not only asking questions both substantive and procedural (for our benefit) but asking or answering questions for the benefit of the important work the Joint Committee is engaged in.

We have discussed our proposal with both Donald Gotterbarn, the task force's ACM Co-Chair, and Robert Melford, the task force's IEEE-CS Co-Chair. Both have welcomed us potential participants as well as observers. [UW: what about Keith Miller, Sagamon State, the working group chair?]

Budget items:

administration and coordination (CSEP, Weil).....	\$1000
three members (3/4 month each @ \$4000/month).....	\$9000
editor (Davis, one month @ \$4000 to draft reports).\$4000	
secretary time (for monitoring e-mail daily).....	\$400
librarian (for incidental research).....	\$200

[subtotal prof. staff.....\$14600]

fringe on prof. staff (25%).....\$3600

graduate student assistant (200 hrs @ \$6/hr).....\$1200

two consultants (2 days each @ \$500/day).....\$2000

subtotal personnel.....\$21450

long distance calls.....\$400

teleconferencing.....\$300

photocopying.....\$150

supplies.....\$350

subtotal "stuff".....\$1200

travel (2 face-to-face meetings for 1 or 2 each)....\$2500

dissemination of results (more travel, same 1 or 2).\$2500

subtotal travel.....\$5000

overhead (56% of \$27650).....\$15484

Total project (right range).....\$43134