

Report to the Board of Governors of the IEEE Computer Society from the Steering Committee for the Establishment of Software Engineering as a Profession

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November 12, 1993

1.0 Background

On May 21, 1993, the IEEE Computer Society Board of Governors approved a motion (Appendix 1) to establish a steering committee for evaluating, planning, and coordinating actions related to establishing software engineering as a profession. The Board of Governors (BoG) also charged this committee to report on its initial plan and progress at the November 12, 1993 Board of Governors meeting to be held in Santa Clara, California.

Pursuant to the motion of the BoG, President Aylor appointed Mario Barbacci as the chairman of the steering committee and discussed the constitution of the committee. The committee started to work in September of 1993 with 6 members (including President Aylor) and were joined later on by one additional members (Schneidewind).

Chairman Barbacci and President Aylor agreed that the November 12 deadline was too short for any definitive proposals to emerge from the group. In fact, they recognized that the magnitude of the task would require the coordinated activities of several task forces, with different assignments and schedules, which would require careful planning. They agreed instead that the steering committee would define a process and agenda for the working committees and task forces, to be appointed later.

The ACM is also interested in the issue of Software Engineering as a profession and, when the BoG action was announced, Stu Zweben volunteered to participate in the task force representing ACM. Thus, one of the issues in the background of the committee's discussions was inter-society cooperation and how to best take advantage of having the US professional computing societies working together. Appendix 2 provides some additional information about the ACM interest. The committee conducted its business almost exclusively by electronic mail although there were a couple of occasions when a couple of committee members had the opportunity to have informal discussions. This process was continued up until the deadline, with the last meeting taking place on Monday, November 8, in Santa Clara, California (Aylor, Barbacci, Buckley, Schneidewind).

This report describes the initial set of conclusions and recommendations of the steering committee to the Board of Governors.

2.0 Definitions

As defined by Webster's New Collegiate Dictionary:

Profession: A calling requiring specialized knowledge and often long and intensive academic preparation; a principal calling, vocation or employment; the whole body of persons engaged in a calling.

Professional: (1) Relating to or characteristic of a profession; engaged in one of the learned professions; characterized by or conforming to the technical or ethical standards of a profession. (2) participating for gain or livelihood in an activity or field of endeavor often engaged in by amateurs; engaged in by persons receiving financial returns.

Professionalism: (1) The conduct aims or qualities that characterize or mark a profession or a professional person. (2) The following of a profession (as athletics) for gain or livelihood.

The International Encyclopedia of the Social Sciences, Volume 12, page 536 [The Mcmillan Company & The Free Press] states that the core criteria for a profession are:

(a) A requirement of formal training accompanied by some institutional mode of validating both the adequacy of the training and the competence of trained individuals,

(b) A requirement that skills in some form of the use of the training must be developed, and,

(c) the profession must have some means of making sure that such competence will be put to socially responsible uses.

These definitions suggest several interlocking components: (a) a set of individuals (b) their education (c) their technical and ethical standards (d) a profit or gain motive (Webster).

Many members of the ACM and the Computer Society consider themselves to be software engineering professionals. However, there are other associations of "software professionals," albeit working on specialized domains (e.g., manufacturing). Thus, linking the

profession with membership in any particular society might be interpreted as self-serving or unduly restrictive. Furthermore, the dictionary says that amateurs often engage in the activity or field of endeavor. Using profit or financial gain as a defining characteristic of a software professional might be not useful, relevant, or fair. The Free Software Foundation (FSF) and people contributing software to the FSF have deeply felt beliefs on this issue, and a great deal of personal computer software is developed and made publicly available for free.

We decided to concentrate on (b) education and (c) technical and ethical standards. We agreed that it should be clear from the outset that we are not interested in "selling" memberships or in excluding groups of people who believe software should be free. That is, it should not matter if a person is a member of any particular society, or charges for her work, but rather that the person has been appropriately educated, applies commonly accepted practices, and adheres to a professional code of conduct.

Focusing our concerns on these two issues is in the spirit of the definition of the term "software engineering" in IEEE Standard 610.12:

Software Engineering: (1) The application of a systematic, disciplined, quantifiable approach to the development, operation, and maintenance of software; that is, the application of engineering to software. (2) The study of approaches as is (1).

This definition of software engineering focuses on acquisition and application of technical standards. It does not address the application of ethical standards. We will cover this issue later on with a specific recommendation.

3.0 Recommendations

Based on these preliminary considerations, we agreed on the following recommendations:

3.1 Recommendation 1: Adopt Standard Definitions

We recommend the adoption of a standard set of definitions. IEEE Standard 610.12 is a good starting place. Other standard glossaries might be appropriate but in any event, these definitions should be carefully examined for appropriateness and scope. This task could be entrusted to the Standards Activities Board of the Computer Society and the appropriate Standards Subcommittee(s).

3.2 Recommendation 2: Define Required Body of Knowledge and Recommended Practices

We recommend the identification of a required body of knowledge and recommended practices (in electrical engineering, for example, electromagnetic theory is part of the body of knowledge while the National Electrical Safety Code is a recommended practice.) The required body of knowledge and recommended practices are not static because technology evolves and the professional, should keep up with the field This activity should be entrusted to a task force of industry experts. Industry should lead the effort because employers know what their software engineers do well, poorly, or indifferently.

Adoption of new practices often requires cultural changes and these processes take years to accomplish. Thus, the initial set of recommended practices ought to be modest and easily achievable. The development and maintenance of the set of recommended practices should be structured like a technical standard: adopted by consensus and subject to periodic revision.

We should not confuse organizational practices with individual practices. Organizational maturity is already the subject of a healthy activity by Software Engineering Process Groups (SEPGs) and Software Process Improvement Networks SPINs). Industry is adopting standards to assess and improve organizational maturity (ISO 9000, SEI CMM) and we should capitalize on these developments but not confuse the issues.

Engaging the process improvement groups might be unconventional but they provide leverage. The SEPGs are almost exclusively attended by industry practitioners concerned with organization software engineering practices and will have something to contribute to the definition of recommended individual practices.

3.3 Recommendation 3: Define Ethical Standards

We recommend to study and customize, if necessary, existing codes already adopted by IEEE, ACM, registration boards, and other relevant organizations. It is not clear that we need something terribly different or specific to software on the grounds that the code of ethics of professionals building antennas, processors, or databases should be different. However, due perhaps to the rapid expansion of the field, software developers sometimes do things that might be considered unethical in other fields (e.g., indiscriminate copying of software in violation of copyrights or licenses.) This task should be charged to the Committee on Public Policy (COPP) of the Computer Society.

3.4 Recommendation 4: Define Educational Curricula

We recommend the definition of curricula for (a) undergraduate, (b) graduate (MS), and (c) continuing education (for retraining and migration). This should be charged to an academic task force drawn from educational boards within the SEI, ACM and IEEE Computer Society, and relevant affiliate societies.

There is a debate as to whether Software Engineering is a part of Computer Science or vice versa. We should not be distracted by this debate from the goal of meeting the needs of industry. The education needed by competent software engineers could be acquired in different ways. For example, we might identify the need for a foundation on statistics; at a given school, the courses could be offered by Computer Science, Software Engineering, or other departments. The objective is to seek agreement on the curricula that should be taught and not necessarily on which departments teach it.

4.0 Approach

To implement these recommendations we will establish and appoint working committees and task forces as necessary to accomplish the steering committee's work. The goal of the steering committee is to pose the questions, and consider and document the issues involved relating to establishing software engineering as a profession. As a part of this, the steering committee will identify the bodies of experts who can contribute to this effort.

Additional activities will include coordinating the work of the steering committee other with Computer Society boards and committees, other professional societies and other communities. Finally, we will organize and facilitate the debates so that the questions and issues are addressed in the appropriate settings and by the right audiences.

The process should be open to the full community. This requires early dissemination of proposals and engaging the appropriate communities. The following meetings are illustrative of suitable venues to gather inputs, identify concerns, and float trial balloons: IEEE International Conference on Software Engineering, SEI Software Engineering Education Symposium, and National Software Engineering Process Groups (SEPG) meetings. These meeting are attended (in different ratios) by software practitioners, computer science and software engineering educators, and technology transition agents.

5.0 Epilog

Our initial work will concentrate on definitions, education, and technical and ethical practices. The four recommendations listed above have implied dependencies and they should be implemented in the order suggested. In particular, it would be imprudent to develop a set of recommendations about curricula that turns out to be inconsistent with the required body of knowledge and recommended practices. The definition of the required body of knowledge and recommended practices should be driven by industry needs and should be developed first. We expect that the industry task force would include members from the academic community to provide an education/academic perspective to those discussions, but would not overemphasize the education area at the expense of the technical area. By the same token, the academic task force should include members from the industry community.

Licensing, certification, and other such regulatory instruments will be addressed next. This is a natural continuation to our first set of recommendations. Only after we identify i the required body of knowledge and recommended practices expected of competent software engineers we could suggest mechanisms to assess their level of competence

In our next report we will expand on all of these recommendations and will offer detailed plans and schedules to implement them.

Appendix I

IEEE Computer Society Board of Governors Enabling Motions (5/21/1993)

Motion 25-1: Buckley moved, Albert-Howard seconded, "MOVED, that the IEEE Computer Society Board of Governors appoint an ad hoc committee to initiate the actions to establish software engineering as a profession (see attachment 25-1 for background information). This work should include:

- a. "Determining, in coordination with the Standards Activities Board, appropriate definitions and establishing those definitions as approved standards in accordance with IEEE Standards Board policies and procedures.
- b. "Determining, in coordination with the Educational Activities Board (EAB), the body of knowledge required for a four-year undergraduate curriculum for a Bachelor of Science in Software Engineering and establishing this as an approved curriculum at the Accreditation Board For Engineering Technology (ABET).
- c. "Determining, in coordination with the Membership Activities Board (MAB), a set of software engineering ethics.
- d. "Encouraging, in coordination with the MAB and the EAB, states to establish software engineering as a registered engineering field consistent with current practices in civil and electrical engineering. Members shalt be appointed by the chair of the ad hoc committee. Membership on the committee shall be open to all interested parties including non-members of the Board of Governors, the Computer Society, and the IEEE. The committee is authorized to initiate its work immediately"

After discussion, this motion was amended by substitution (see motion 25-3) .

Motion 25-2: Chikofsky moved, R. Williams seconded, "MOVED, that motion 25-1 be substituted with motion 25-3. " Motion carried by a count of 15-2-5 .

Motion 25-3: Chikofsky moved, R. Williams seconded, "MOVED, that the Board of Governors of the IEEE Computer Society establish an ad hoc committee, appointed by the president, to serve as a steering group for action, planning, evaluation, and coordination related to establishing software engineering as a profession, subject to:

1 The ad hoc committee (the steering group) will be composed of well-respected individuals (such as IEEE Fellows from the Computer Society's software engineering community, others of similar standing, and representatives of involved Computer Society units) with a balance of industry, research, and academic backgrounds.

- 2 The committee will coordinate on this issue with the various Computer Society boards and committees, other professional societies, and other communities.
- 3 The committee will establish and appoint task forces and working groups as necessary to accomplish the committee's work, with membership open to interested parties including non-members of the Computer Society and the IEEE.
- 4 The various proposals presently submitted are referred to the committee for appropriate action to advance software engineering as a profession.
- 5 The committee is charged to report on its initial plan and progress at the time of the November 1993 Board of Governors meeting."

Motion 25-4: Hoelzeman moved, Chikofsky seconded, "MOVED, that numbered paragraph 4 of motion 25-3 be amended as follows" Motion carried by a count of 20-1-2.

Consider and document the issues associated with software engineering as a profession including, but not limited to:

The factors involved in, and the value thereof, of establishing software engineering as an approved program including the associated accreditation issues.

The factors involved in, and value thereof, of establishing a separate set of software engineering ethics.

The factors involved in, and value thereof, of establishing software engineering as a certified or registered field.

Motion 25-3: After discussion, motion carried as amended by a count of 18-14.

Action: President. Due: ASAP. BOG 5/93. 25-3. Appoint Ad Hoc Committee on Software Engineering as a Profession.

Action: Chair, Ad Hoc Committee on Software Engineering as a Profession. Due: 11/12/ 93. BOG 5/93.25-3. Report on initial plan and progress of the committee at the November 1993 Board of Governors meeting.

Appendix 2

ACM Council Resolution (8/93)

As background for our discussion, Stu Zweben described actions taken at the August 1993 meeting of the ACM Council. In that meeting, the Council endorsed the establishment of a Commission on Software Engineering to address a number of questions relating to 1) the terminology used to describe software engineering and those who work in the software area; 2) the identification of generally accepted and desired standards of good software practice; and 3) our ability to identify, educate, and train individuals who are competent with software engineering and design.

"Council endorses the establishment of a Commission on Software Engineering to address the questions contained in Council backup, Item 3.7, Pages 3-4 of 7. If possible, this activity shall be done jointly with the IEEE Computer Society. The Executive Committee shall appoint (ACM's) members of the commission, provide it with a reasonable expense budget, and take other steps as may be necessary to assure that the commission may complete its work in a timely fashion."

The text of the material on pages 3-4 of 7 alluded to in the resolution reads as follows:

Draft 8 (SHZ) 7/15/93
ACM Commission on Software Engineering

Background:

There are ongoing concerns about the persistent inability to construct software systems that are reliable, dependable, usable, on time, and within budget. These concerns are exacerbated by the widening reliance on computers and networks for conduct of all business and other human activities, and by the increasing role of software in supporting human activities of all kinds. The term "software engineering" is typically used to designate the broad field of study and practice that addresses these concerns. Terms such as "software design" and "software architecture" also have been used for this purpose, to focus attention on important and fundamental questions that must be answered satisfactorily before good software can be built routinely.

ACM has a long history of interest in these concerns. A large fraction (about 40%) of its members are professionally directly involved with software development. Through its SIGs (especially SIGSOFT and SIGCHI, and their newsletters and many conferences), publications (especially TOSEM, TOCHI, and the new INTERACTIONS), education activities (such as "Computing as a Discipline" and curriculum recommendations), and public policy activities (such as the RISKS forum), ACM plays a major role in defining the states of the art and practice of the broad software engineering field. ACM also has a long history of involvement and cooperation with IEEE-CS in many of these endeavors.

As the software engineering field matures and society places increasing demands and reliance on software systems, there is a need to increase the overall quality and reliability of these systems, to raise the level of responsibility and accountability of those who develop them, and to increase public confidence in them. Terms such as "discipline" and "profession" have been used to characterize software

engineering, and to argue for varying degrees of regulation for individuals in this field. At the same time, strong objections to these characterizations and to any regulatory efforts have been voiced. There are strong disagreements about whether software engineering is properly regarded as engineering, whether software engineering adequately covers all relevant aspects of design, whether software engineering should be separated from computer science, and whether software engineering is mature enough to be called a discipline.

ACM therefore feels that the time is now ripe to assess where we are as a field with respect to software engineering. There is a strong need to clarify terminology, to identify both generally accepted and desirable standards of good software practice, and to further our ability to educate and train individuals to be competent with software engineering and design.

Action:

The ACM chatters a Commission on Software Engineering to provide a white paper that assesses the field of software engineering relative to the issues raised above. The commission will address the following questions.

1 What activities are usually considered part of software engineering? How is design currently formulated within software engineering? What other formulations of software design are in use? How can they be brought together?

2 What is a profession? What is the state of software engineering as a profession?

3 What is a discipline? What is the state of software engineering as a discipline?

4 What standard practices currently exist for software engineering? How do they compare with those in other fields recognized as disciplines or professions?

5 What responsibilities are generally expected of persons with the title of "software engineer"? "Designer"? "Architect"? Are there useful distinctions in the responsibilities of persons with related job titles?

6 What are the important issues to be confronted within the various sub areas of software engineering?

7 What are the implications of the above for education? Curriculum? Accreditation?

8 What are the implications of the above for certification? Licensing?

9 What actions are recommended for ACM?

The commission should include leading people from software engineering, academia, industry, and government. It should gather information from other knowledgeable groups and from related published material, and should cooperate with other organizations having an interest in similar questions.

Due Date:

The Commission should complete its work by April 30, 1994.

Appendix 3

Membership of the IEEE Computer Society Steering Committee for the Establishment of Software Engineering as a Profession

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