

CERTIFICATION PAGE

Certification for Authorized Organizational Representative or Individual Applicant:

By signing and submitting this proposal, the individual applicant or the authorized official of the applicant institution is: (1) certifying that statements made herein are true and complete to the best of his/her knowledge; and (2) agreeing to accept the obligation to comply with NSF award terms and conditions if an award is made as a result of this application. Further, the applicant is hereby providing certifications regarding debarment and suspension, drug-free workplace, and lobbying activities (see below), as set forth in Grant Proposal Guide (GPG), NSF 04-23. Willful provision of false information in this application and its supporting documents or in reports required under an ensuing award is a criminal offense (U. S. Code, Title 18, Section 1001).

In addition, if the applicant institution employs more than fifty persons, the authorized official of the applicant institution is certifying that the institution has implemented a written and enforced conflict of interest policy that is consistent with the provisions of Grant Policy Manual Section 510; that to the best of his/her knowledge, all financial disclosures required by that conflict of interest policy have been made; and that all identified conflicts of interest will have been satisfactorily managed, reduced or eliminated prior to the institution's expenditure of any funds under the award, in accordance with the institution's conflict of interest policy. Conflicts which cannot be satisfactorily managed, reduced or eliminated must be disclosed to NSF.

Drug Free Work Place Certification

By electronically signing the NSF Proposal Cover Sheet, the Authorized Organizational Representative or Individual Applicant is providing the Drug Free Work Place Certification contained in Appendix C of the Grant Proposal Guide.

Debarment and Suspension Certification

(If answer "yes", please provide explanation.)

Is the organization or its principals presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency?

Yes

No

By electronically signing the NSF Proposal Cover Sheet, the Authorized Organizational Representative or Individual Applicant is providing the Debarment and Suspension Certification contained in Appendix D of the Grant Proposal Guide.

Certification Regarding Lobbying

This certification is required for an award of a Federal contract, grant, or cooperative agreement exceeding \$100,000 and for an award of a Federal loan or a commitment providing for the United States to insure or guarantee a loan exceeding \$150,000.

Certification for Contracts, Grants, Loans and Cooperative Agreements

The undersigned certifies, to the best of his or her knowledge and belief, that:

(1) No federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure of Lobbying Activities," in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, Title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

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EESE: Learning Units on Law and Ethics in Software Engineering

This award is made under Ethics Education in Science and Engineering (Solicitation 06-524).

Breadth of Impact:

This project will develop learning units that focus on topics of such active public interest that there is ongoing, rapid change in the laws that provide context for discussions of the associated professional ethics issues. Examples include whistleblowing; reverse engineering; investigation of security vulnerabilities in running systems; and conflicts of interest and intellectual property rights associated with university labs and faculty-owned businesses that commercialize university-developed research. Each topic can be studied in terms of ethics issues that the student might face while conducting research as a student or later, as a faculty member (supervising research students) or as an engineer working in industry. All of these are important for software engineering; several are also significant for other engineering areas and the materials can be developed modularly, so that they can be easily customized for other areas. The learning units will be published electronically at the project website and submitted to peer-reviewed course collection sites, such as MERLOT.org. All materials will be made available to the public via publication on the web under a Creative Commons license that allows free distribution and customization or in well-indexed academic journals or conference proceedings.

Intellectual merit:

The instructional approach of these materials is already in use at Florida Tech and was developed by the Principle Investigator under a previous NSF-funded project: ITR/SY+PE: Improving the Education of Software Testers (Black Box Software Testing course at <http://www.testingeducation.org/BBST>). In a follow-up project, a coalition of universities, corporations and independent trainers are applying, assessing and improving the approach. Their ongoing progress will guide this work.

Under this approach, students watch video-based lectures before coming to class. Class time is spent on instructor-guided activities that have obvious relevance or application. In this project, each learning unit will provide video lectures and slides, background briefing papers including a literature review that explains the engineering and engineering ethics issues to the law-specialist reader and another review that explains the legal issues to the engineering reader, study guide questions, grading suggestions in a restricted-access website for instructors, suggestions for in-class activities, and guidance for the student who will search the legal and engineering literature to gain the most current information on the issues covered in this learning unit. This multimedia blended learning approach is suitable for classroom instruction (watch video lectures at home, do coached activities in class) and web-based instruction.

The principle investigator, Cem Kaner is an attorney whose principle legal focus is computer-related law, and a widely known author on software quality control. Senior investigator Richard Ford is an expert in computer security, especially the study of mobile malicious code, and in reverse engineering. Kaner and Ford both have extensive industry experience. Senior investigator Scott Tilley is an expert in reverse engineering and program comprehension. He is President of ACM SIGDOC. Collectively, the investigators bring complementary expertise in the legal, technical and instructional issues underlying this project.

The learning units will be initially developed at Florida Tech, posted on the project website, and publicized via conferences and mailing lists. Experience with the Black Box Software Testing course is that as the project provides materials of value and builds credibility, external instructors and subject matter experts will use the materials and agree to provide detailed feedback. Recruiting and collaborating with external colleagues that is focused on the specific individual learning units is an inherent part of this work.

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*Proposers may select any numbering mechanism for the proposal. The entire proposal however, must be paginated. Complete both columns only if the proposal is numbered consecutively.

EESE: Learning Units on Law and Ethics in Software Engineering

I propose to develop instructional support materials for three to five learning units on engineering ethics that could be incorporated into a variety of other engineering courses.

Materials

The materials for a learning unit would include video lectures, slides, supplementary readings, suggested classroom activities, homework assignments and potential examination questions, along with grading notes.

Instructors are free to use this type of material to support whatever teaching structure they prefer. For example, at Florida Tech, students watch the video lectures at <http://www.testingeducation.org/BBST> before coming to class. We use classroom hours for instructor-guided activities, and follow these up with assignments that students work on in teams, sharing information within and across teams via online discussion forums. Students give us detailed feedback using the *Student Assessment of Learning Gains* and report both that the material is effective and that they work unusually hard in the course (Kaner & Fiedler, 2005a, 2005b).

Instructors at other universities and companies that provide in-house training to their staff are also using these materials. I have submitted a separate proposal to assess and refine the testing materials and the instructional approach. (DUE: CCLI Curricular Support for Software Testing). As one indicator of the reception of these materials, an international team of universities, companies and small training firms joined us in that proposal, committing themselves in writing to a 3-year assessment plan. These include Dalhousie University (Halifax), DevelopSense (Toronto), Huston-Tillotson University (Austin), PerfTestPlus (Palm Bay, FL), Quardev Laboratories (Seattle), The Riga Information Technology Institute (Latvia), Safeco Insurance (Seattle), Satisfice Inc. (Front Royal, VA), Texas Instruments (Dallas), and Vipul Kocher (India). Even if that proposal is not funded, we expect to do *some* of this work with private support. All of this work will help us refine the instructional approach that is the basis for this proposal's materials.

The instructional approach and types of materials proposed for engineering ethics are directly comparable to the work already successfully done on the testing course.

I will publish the instructional materials on the Web under a Creative Commons license that allows free use and modification, and submit them to the MERLOT (Multimedia Educational Resource for Learning & Online Teaching) Community for peer review (MERLOT Community, 2004).

Content

Content areas for the learning units would be drawn from work that my colleagues, students and I do on:

- whistleblowing;
- the current legal status of reverse engineering;
- constraints on reporting research results;
- intellectual property rights, agreements, and plagiarism in laboratory research;
- management of conflicts of interest when students do academic research in the context of a faculty/university owned business;
- legal and ethical considerations in penetration testing (and other aspects of security-related research);
- the reach of malpractice liability to engineers in academic settings, commercial settings (working as an employee) and professional settings;

- Commercial liability for defective products.

We will work on all of these, but drop some as we discover which are more tractable, which capture the imagination of individual students helping do the research, and which are well enough covered by other researchers.

The content bias of this work emphasizes legal issues. Especially in software engineering, laws that provide context for discussions of professional ethics have been changing rapidly. The project will provide both:

- up-to-date materials, and
- guidance to engineering students on how to do their own legal research so that they can have updated materials at the time they actually need them.

We are experienced in these areas:

- As an attorney, my focus is computer law. The American Law Institute (ALI) elected me as a member in 1999 in recognition work on computer-related legislation. The ALI is an enormously influential organization whose works are regularly cited in appellate court opinions. Election to ALI is roughly comparable to being named a Fellow of an engineering professional society. I have also taught tutorial sessions to faculty on teaching ethics to software engineering students (Kaner, 2002b, 2002c) and wrote a book on software consumer protection.(Kaner & Pels, 1998).
- Senior investigator Scott Tilley has worked in the area of software reverse engineering for nearly 15 years. He has extensive expertise in matters related to reverse engineering technology, legitimate applications of reverse engineering (e.g. program understanding), and underlying theories of related canonical activities (e.g., data gathering, knowledge management, and information exploration). He has developed and taught a graduate course on software maintenance & evolution that includes material on reverse engineering. He has published extensively in the area, served in a number of capacities for international conferences (e.g., General Chair, Program Chair, Committee Member) related to reverse engineering, and is currently co-authoring a book on program redocumentation. More recently, he has worked in the area of intellectual property, digital rights management, and risk analysis for online and Web-based content.
- Senior investigator Richard Ford is an expert in computer security research. He focuses on malicious mobile code, penetration testing, and anti-reverse-engineering techniques and is Senior Editor of Reed-Elsevier's *Computers & Security*. Prior to returning to university research, Dr. Ford gained extensive commercial experience, including service as Director of Engineering at Verio, where he managed all new research and development associated with the hosting of over 300,000 web domains and as a security researcher at IBM's T.J. Watson Laboratories.

CONTENT SUMMARIES

In a 15-page proposal, there is insufficient room for a scholarly overview of each of the proposed content areas. The notes that follow provide more detail on the first two topics, and briefer sketches of the rest. I hope this is sufficient for you to understand and evaluate the proposal.

Whistleblowing

The primary software-related codes of ethics published in the United States urge professional software developers to be whistleblowers:

Software engineers shall act consistently with the public interest. In particular, software engineers shall, as appropriate: ... 1.04. Disclose to appropriate persons or authorities any actual or potential danger to the user, the public, or the environment, that they reasonably believe to be associated with software or related documents. (ACM/IEEE-

CS Joint Task Force on Software Engineering Ethics and Professional Practices, 1999, Principle 1: "Public")

In the work environment the computing professional has the additional obligation to report any signs of system dangers that might result in serious personal or social damage. If one's superiors do not act to curtail or mitigate such dangers, it may be necessary to "blow the whistle" to help correct the problem or reduce the risk. However, capricious or misguided reporting of violations can, itself, be harmful. Before reporting violations, all relevant aspects of the incident must be thoroughly assessed. In particular, the assessment of risk and responsibility must be credible. It is suggested that advice be sought from other computing professionals.
(Association for Computing Machinery, 1992, Section 1.2 "Avoid harm to others")

There are only a few articles on whistleblowing in the computing literature. A search for articles on "whistleblow*" yields only 23 hits in the Association for Computing Machinery's Guide, few of them focused primarily on whistleblowing and none on the governing laws. Unfortunately, in the thirteen years since I started paying professional attention to whistleblowing engineers (Kaner, 1993), American laws have changed significantly (Lenzo, 2004; Westman & Modesitt, 2004, supplemented 2005). As a general rule (with significant exceptions), an employee or consultant who breaches a nondisclosure agreement to report wrongdoing by the employing organization is now more vulnerable to retaliatory discharge and retaliatory litigation even (in some circumstances) in the reports of government contractor misconduct or reports to government authorities. If we agree that governing law is one expression of societal ethical guidelines, that acting within the spirit and letter of governing law is generally regarded as a professional obligation, and that potential consequence to self is also relevant in ethical decision-making, then the shifting legal landscape is important for a course teaching software engineering students about ethical evaluation.

The same legal analysis applies to the other engineering professions. Our academic comfort zone is software engineering but we have broader backgrounds (Ford's Ph.D. is in Physics; Kaner has worked more broadly as an attorney on products liability, toxic torts, and criminal prosecution and has five years work experience as a human factors analyst). Our materials would include examples from other engineering areas.

The rapid changes in whistleblowing law illustrate the need to go beyond the current legal situation because the "current" situation will change by next year. This is why one of this project's key objectives is to help students develop the skills and strategy needed to do their own research to update the materials we provide. Without this, they won't have the right information available when they actually need it.

Whistleblowing also illustrates the diversity of situations for which students need guidance:

- In her role as a graduate student, a person may face evidence of financial misconduct or misconduct in collection or reporting of data in the lab where she works.
- Later in his career as a professional employee in a business or government agency, a person might be a witness to (or participant in) misconduct. In contrast with the student situation, this employee might be bound by tighter nondisclosure agreements, in an organization that has less interest in academic freedom. This misconduct might be integral to the business style of the organization rather than isolated misbehavior of one or a few people inside the organization.
- Or, later in her career, in her role as an ethical faculty member running her own lab, a person might supervise a disgruntled student who threatens to file an unfounded ethics complaint. What are the rights of that student and what actions would be wise or unwise in such a case?

The materials that we plan to develop for whistleblowing—and for most of the other topics—would address each of these contexts (student, faculty member, applied professional).

Reverse Engineering

Reverse engineering is the process of analyzing source code (and related artifacts) to generate higher-level views of the subject system. One of the most beneficial applications of reverse engineering is to aid program understanding in support of software maintenance and evolution. Another is to gain insight into security or quality risks associated with a product so that the user can mitigate those risks (Kaner, 1998). Gaining sufficient understanding of a complex software system is an arduous task, involving inverse domain mapping on the part of the developer. Reverse engineering tools can automatically analyze low-level source code artifacts to produce high-level views of the subject system, thereby facilitating overall comprehension.

Historically, reverse engineering has been fully protected as a “fair use” activity under the Copyright Act (Sony Computer Entertainment, Inc. v. Connectix Corp., 1999).

A recent decision (Bowers v. Baystate Techs, 2003) defined reverse engineering so broadly (“to study or analyze (a device, as a microchip for computers) in order to learn details of design, construction, and operation, perhaps to produce a copy or an improved version”) that the decision appears to bar black box reverse engineering (study of the product through analysis of its behavior) as well as decompilation/disassembly or structural analysis of its source code. In the face of a license agreement that bars reverse engineering—even a non-negotiable mass-market license that the customer isn’t even allowed to examine before buying the product—reverse engineering may be barred (Davidson & Assocs. v. Jung, 2005; Fitzgerald, Cifuentes, Fitzgerald, & Lehmann, 2001; Imfeld, 2003; Samuelson & Scotchmer, 2002; Sullivan & Morrow, 2003).

Along with legal measures to prevent reverse engineering, some large corporations have been funding academic research aimed at improving technical measures intended to make reverse engineering more difficult. For example, a recent thesis supervised by Ford and Tilley (Parveen, 2005) presents a novel approach for detecting the presence of an emulated execution environment. The use of an emulated environment is one of the more advanced techniques used for thwarting digital rights management systems to illicitly obtain privileged content. Execution of an application in such a setting can pose a threat to software security and potentially increases the risk of data piracy. However, if the presence of an emulated environment can be detected, technologies can be developed to protect software systems from the risks associated with this method of reverse engineering.

- What is the current state of the law on reverse engineering? We think American law is unsettled.
- What is the current state of the law on reverse engineering outside the United States—does a ban on reverse engineering create a competitive advantage or disadvantage? What arguments favor each position? Is there data?
- Under what circumstances is it lawful for American students to create or use reverse engineering tools as part of their research?
- What are the societal implications of a ban on reverse engineering? Should the law permit reverse engineering for some purposes even if a contract clause forbids reverse engineering generally?

Professors Ford, Tilley and I disagree on several of the policy answers. The materials are intended to highlight controversies in the field.

Additional topics

Here are notes on the other proposed topics. We are presenting these briefly to preserve space for the rest of the proposal.

- ***Constraints on reporting research results.*** Some constraints are imposed by statute as a matter of public policy, such as prohibitions in the Digital Millennium Copyright Act (DMCA). Others are

rooted in private contractual agreements (nondisclosure clauses in employment contracts). How appropriate are such contracts for graduate student research? Can confidential work be a basis for a dissertation? Some universities have published standards on this issue (e.g., Stanford University, 1996). How do they differ? What rationales support the differences? Suppose that a researcher discovers a security flaw in a widely used program and publishes the discovery in a way that is not barred by statutes like DMCA. If this publication inspires wrongdoers to exploit the security flaw, should the researcher be considered ethically culpable for the harm caused by the exploits? What about legally liable?

- ***Intellectual property rights, agreements, and plagiarism in laboratory research.*** What rights do/should undergraduate and graduate students typically have to research they do at school? How do laboratory intellectual property policies and agreements affect those rights? What are some of the ways in which these policies and agreements vary across universities or labs? What rationales support the differences? What are some of the key distinctions between plagiarism and copyright infringement? When should use (without citation) of material developed within the lab by a person who did not develop it (including use by a financially-supporting faculty member) be considered permissible and when plagiarism or infringement?
- ***Management of conflicts of interest when students do academic research in the context of a faculty/university owned business.*** Many faculty set up private businesses that sell technology, or services based on technology, that was discovered as part of their university research. To a degree that varies across universities, the intellectual property rights to the invented technology might be owned or co-owned by the university. The faculty member might partner with the university to sell consulting, training or custom development services that arise out of an invented technology or might go into business alone. Whether a purely faculty activity or a joint faculty-university venture, several employees of the venture are likely to be students. Sometimes these are graduate students, doing thesis research that is supported by the business. There is enormous potential for conflict of interest among the university, the faculty member, and the employed inventor-student. My impression as an attorney, based partially on watching formation and supervision of a few such businesses, is that less highly influential guidance has been published in this general area than is desirable and that decision makers associated with formation, approval and university-side monitoring of the activities of such organizations are often insufficiently informed about what guidance is available to them. Professor Ford gained the same impression as CTO of Cenetec, a venture capital investment firm that helped form such companies. This is another clear case in which material should be developed for multiple audiences: the student as student, the student as potential faculty-researcher, the student as potential administrator, the student as potential businessperson providing capital and other support for the startup of such a business. In tackling this work, I would expect to collaborate with another faculty member who has a broader range of experience with these types of contracts. I have not yet identified this person but have budgeted for some funding for her or his contribution.
- ***The reach of malpractice liability to engineers in academic settings, commercial settings (working as an employee) and professional settings.*** Unlike medicine, accounting and law, a non-licensed engineer can (often) practice her or his profession as an employee of a company. As a result, many practicing engineers (including many people who graduated with engineering degrees) are fully employed in their field but are not licensed professional engineers. Under what circumstances, if any, can they be held accountable for professional negligence? For those people who *are* licensed engineers, under what circumstances can they be held accountable for professional negligence and why? What is the rationale for treating them differently from the in-house engineer? Malpractice law has traditionally been inapplicable to the development and maintenance of computers and software (Kaner, 2000). However, software engineering is on the threshold of becoming a licensed profession. Compared to the other engineering fields, what would legal analysis of an accusation of professional negligence of a software engineer look like?

- **Commercial liability for defective products.** The Uniform Computer Information Transactions Act (National Conference of Commissioners on Uniform State Laws, 2002) defined a new law of licensing for mass-market software products. It made enforceable unmodifiable contracts that ship with the software but are not available to the customer until after payment for the product and delivery are complete. Examples of some of the contract terms that appear enforceable under UCITA are blanket warranty disclaimers and limitation of accountability for losses caused by defective products to nominal amounts, and a wide array of use restrictions placed in these licenses. Examples of use restrictions that might be enforceable under UCITA, *even for products sold in the mass market*, are blanket prohibitions of reverse engineering, on performing or publishing benchmark studies of the software, and of publishing critical reviews of the product. UCITA has been rejected in most states, adopted in only Virginia and Maryland. However, several courts have issued opinions fully consistent with the reasoning and policy of UCITA, broadening its reach to much of the country (Grierson, 2004; I. Lan Sys. v. Netscout Serv. Level Corp., 2002; M.A. Mortenson Co. v. Timberline Software Corp., 2000; Rinaldi v. Iomega Corp., 1999). UCITA was ostensibly about software, but it reaches to software embedded in traditional products (such as cars) and the policies underlying UCITA have been applied by courts to several other types of products (Friedman, 2004; Hill v. Gateway 2000, 1997; O'Quin v. Verizon Wireless, 2003). These issues are fundamental for all engineering students at all levels because they define the responsibility of the engineering community to the public for the quality of the products they produce. As with the issues of professional responsibility, engineers have a duty of care to the public and as an ongoing part of their training, they should be made aware of it.
- **Legal and ethical considerations in penetration testing (and other aspects of security-related research).** The laws governing penetration testing are complex and often ill-understood. Furthermore, the more general topic of security research raises many difficult legal and ethical questions. For example, social engineering techniques are often extremely effective in penetration tests (Mitnick & Simon, 2002). However, deceiving one's own employees is ethically questionable. Furthermore, a real attacker would not limit her attacks to just the company but would also pursue those who have a business relationship with the target (such as the Internet service provider, or companies who have been granted limited VPN access to the corporate network). As such, a complete penetration test which accurately models the actions of an attacker is considerably broader than one might wish. Here are examples of some of the questions of interest. Answers will often vary with the legal jurisdiction(s) associated with the attack.
 - Who has the right to conduct a penetration test and under what circumstances. Who has the authority to authorize someone to conduct a penetration test on their (or another's) organization's systems?
 - Should a simulated attacker be limited solely to machines directly controlled by the company?
 - What is the liability if actual damage is caused unintentionally during a penetration test?
 - What limits should be placed on the social engineering aspects of a penetration test?

Deliverables

Each learning unit would deliver the following:

- **A video lecture** (broken into short, coherent segments) for engineering students that presents an overview of the topic and the key legal and ethical considerations and controversies associated with it.

One of these segments would identify relevant sections in the *ACM Code of Ethics and Professional Conduct* (Association for Computing Machinery, 1992), and the *Software Engineering Code of Ethics and Professional Practice* (ACM/IEEE-CS Joint Task Force on Software Engineering Ethics and Professional Practices, 1999). As

appropriate, and as within our competence, there would sometimes be parallel segments for one or more other areas of engineering.

- ***A literature review that presents the legal issues involved in this topic to the engineering community***, with supporting background summary of the engineering issues (technological and economic), ethical discussions on this topic, and the relevant engineering ethical standards documents (see, for example, Center for the Study of Ethics in the Professions, undated; Online Ethics Center for Engineering and Science, undated). I have experience writing about law for a non-legal audience (Kaner, 2002d, 2003d, 2004c, 2004d, 2004g; Kaner & Pels, 1998) and might be able to build a better bridge than some other writers in the field.
- ***Detailed suggestions for engineering students on how to update the literature review on this topic***—this would typically be a combination of printed material and video lecture.
 - ***A literature review that presents the engineering issues involved in this topic to the legal community***, with supporting background summary of the legal and ethical discussions on this topic.
- ***An annotated list of recommended readings*** for use in the course that uses this learning unit.
- ***Study guide questions*** (essay and objective style questions)
- ***A password-protected assessment support area*** with suggested multiple-choice and essay questions and grading guides, available only to university faculty or corporate training or ethics officers.
- ***Additional descriptions of suggested in-class activities and out-of-class assignments*** (with links to case studies and other activities on this topic already developed by others), with grading guides and experience reports in the password-protected area.
- ***Discussion forums*** (one public, one in the password-protected area) for students and other professionals to critique, update or extend the work.

In addition, as general material to support all of the learning units, I would develop and deliver the following:

- ***A video lecture set for engineering students that explains legal research.*** My objective is not to make them lawyers. It is to give them tools to update the summaries of the law that they get in courses and outdated ethics books. I would cover such topics as:
 - Use of the main legal databases, such as Lexis, WestLaw, VersusLaw and the leading free sites (findlaw.com, for example). Universities differ in access to the main databases, so I expect to provide materials that would be redundant in a school that has access to everything, in order to support students who have access only to one of the main systems.
 - Searching by citation rather than by topic or keyword and why this is so important in legal research.
 - How to find and use statutes, court opinions, regulatory opinions, and law review articles. Law reviews have a fundamentally different place in legal work (they are secondary source materials—the statutes and opinions are the primary sources).
 - How to understand legal citation style.
- ***Supplementary printed material, with exercises for engineering students.***
- ***Links to tutorial sites that help students learn legal research.***

DEVELOPMENT PLAN

To assist in the literature reviews, I intend to recruit a law student intern each summer. I also expect to supervise independent study classes for local undergraduates interested in pursuing a legal career after graduating with their science or engineering degree. I am supervising such a study on whistleblowing this term.

I am very familiar with the legal databases and have coached individual students through navigation of them. However, to prepare archival tutorials on this, I would expect to hire a library sciences student as a research assistant or to collaborate with a research librarian. In anticipation of the likelihood that I will work with a research librarian instead of a student, I have included a request for funds for consultation. If the librarian is also at Florida Tech, I would spend this as “summer support” faculty salary instead. However, work with a law librarian is at least as likely. There are many online tutorials for law students but I have not seen any good ones designed for engineers who are trying to do scholarly research that includes legal sources. Part of my process in finding a collaborator/consultant on this work will be a review of the tutorials available, looking for someone likely to communicate legal research ideas well to nonlawyers.

The work plan is clearer for some topics than others. Not all of these topics will yield viable material. I plan to try several topics but complete work on three to five topics. Which ones complete will depend such factors as on the interests of the students who join the project, the tractability of the material, and the extent to which work on a topic seems redundant with others’ work.

Fall 2006-Spring 2007

I have not identified students who would start on the project in Fall 2006. Therefore, recruiting appropriate students is one of the tasks for this term. I cannot assume that appropriate research students join the project until Summer 2007.

- **Logistics.** Hire a student research assistant as system administrator and coordinator of other lab logistical issues. Open a lab website with private and public areas. Install a Moodle course management server as a public area. (Moodle, at <http://www.moodle.org>, is a free software CMS that facilitates peer interaction among online participants.) This will host the materials as we develop them, with discussion forums. Some materials will be restricted to members of the research team, others to researchers plus faculty, others open to anyone who registers at the site. Set up access to a web-based project tracking server, which the project team will thereafter use to track and report status on the components of this project.

All materials that published on this site will be freely distributable under a Creative Commons license except for material that we have published in a professional journal that restricts redistribution. I also expect to submit these materials to other online course repositories, such as MERLOT.org.

- **Whistleblowing.** Complete the whistleblowing literature review (explain law to engineers). Submit a summary article of general interest to software engineers (such as Communications of the ACM or IEEE Software), submit a thorough review to an engineering journal that publishes literature reviews or scholarly papers on ethics and society. Complete a literature review (explaining the engineering issues to lawyers) for the American Law Institute’s committee writing the *Restatement of Employment Law* (I belong to the Members Consultative Group for this Restatement).
- **Reverse engineering.** Publish brief announcements of our intent to work in this area to legal and engineering groups and individuals who are likely to consider themselves stakeholders. Invite them to submit documents for our review and to join a panel that reviews the materials we create for fairness and accuracy.

- **Malpractice liability.** Publish brief announcements of our intent to work in this area to legal and engineering groups and individuals who are likely to consider themselves stakeholders. Invite them to submit documents for our review and to join a panel that reviews the materials we create for fairness and accuracy.
- **Commercial liability.** Begin a complete restructuring of Kaner's site, www.badsoftware.com. This will become the lab's commercial liability site. Kaner has recaptured rights to his book, *Bad Software: What To Do When Software Fails* (Kaner & Pels, 1998). Publish the original book on the site and set up an editable version in a way that invites public comment. The new version will gradually evolve into a work that is more up to date and that reflects more views (with a diversity of identified contributions).
- **Penetration testing.** Publish brief announcements of our intent to work in this area to legal and engineering groups and individuals who are likely to consider themselves stakeholders. Invite them to submit documents for our review and to join a panel that reviews the materials we create for fairness and accuracy.
- **Conflicts of interest.** Publish brief announcements of our intent to work in this area to legal and engineering groups and individuals who are likely to consider themselves stakeholders. Invite them to submit documents for our review and to join a panel that reviews the materials we create for fairness and accuracy.
- **Constraints on reporting.** Publish brief announcements of our intent to work in this area to legal and engineering groups and individuals who are likely to consider themselves stakeholders. Invite them to submit documents for our review and to join a panel that reviews the materials we create for fairness and accuracy.
- **IP rights and plagiarism in laboratory research.** Publish brief announcements of our intent to work in this area to legal and engineering groups and individuals who are likely to consider themselves stakeholders. Invite them to submit documents for our review and to join a panel that reviews the materials we create for fairness and accuracy. Collect and publish or link to several agreements in use in university research labs.
- **Tutorials on legal research for engineers.** Outline the tasks that an engineering student would typically perform. Invite comment from Lexis and WestLaw.

Summer 2007

Supervise the work of the legal intern, a student with library research skills and/or a student with multimedia development skills.

- **Whistleblowing.** Guided by feedback from the *Restatement of Employment Law* meeting and comments on that draft from other counsel, prepare a draft for law review publication. Develop first-draft course slides. Look for published case studies and other whistleblowing-related activities. Develop first-draft activities and review questions.
 - **Reverse engineering or penetration testing.** Richard Ford will lead the work in this area, probably with support of a student researcher. Identify key sources and controversies in one or both of these areas. Develop a topic structure for the literature review. Begin searching the legal and engineering literatures for relevant papers and cases. Create local electronic copies of key sources and begin annotating them by topic.
- **Malpractice liability.** No significant progress expected this term. Keep a web page active (probably set up as a Moodle course open to any registrant) that invites comments and suggested sources.

- **Commercial liability.** Update several discussions in *Bad Software*. Propose conference papers on warranty liability, EULA enforceability, and so on. Scan current computer law/ethics texts for coverage of commercial liability issues. (I have examined several already and consider the coverage remarkably light.) Begin a search for case studies and other instructional support materials already on the Web.
- **Conflicts of interest.** No significant progress expected this term. Keep a web page active (probably set up as a Moodle course open to any registrant) that invites comments and suggested sources.
- **Constraints on reporting.** No significant progress expected this term. Keep a web page active (probably set up as a Moodle course open to any registrant) that invites comments and suggested sources.
- **IP rights and plagiarism in laboratory research.** No significant progress expected this term. Keep a web page active (probably set up as a Moodle course open to any registrant) that invites comments and suggested sources.
- **Tutorials on legal research for engineers.** Lang leads this work with support from Kaner and the law student. Develop sample searches, capturing the process in voice-annotated videos. For the samples, track which types of searches / sources yielded what type of information. Identify key tutorial sources for legal-source literature reviews.
- **Complete the Year 1 status report for NSF.**

Fall 2007-Spring 2008

I expect to have a system administrator and one or two research undergraduates on the project. By this point, we will be making triage decisions on some of these topics. The actual list of work at this point will be narrower and more focused than this list.

- **Whistleblowing.** Complete the suite of materials. Submit an additional literature review for engineers to a journal that appeals to a different or broader engineering community than those focused on software engineers. Try out these materials in at least one Computer Law/Ethics/Society course and collect detailed student feedback. Aggressively seek feedback from faculty at other schools.
- **Reverse engineering or penetration testing.** Publish (submit for publication) one or more of the literature reviews, create course slides and videos, do at least one practice teaching of the material.
- **Malpractice liability.** Begin collecting cases on engineering malpractice and identifying underlying themes. What similarities and differences are there among different engineering areas? Offer to present a comparative review to at least one conference that draws malpractice litigators (make the offer in Spring 2008, with intent to make the presentation in Fall 2008.)
- **Commercial liability.** Continue the incremental updating of the badsoftware site. Publish a draft set of course slides.
- **Conflicts of interest, constraints on reporting, IP rights and plagiarism in laboratory research.** Find a student (in this term, or for the summary) who has an interest in one of these areas and focus his or her work on it.
- **Tutorials on legal research for engineers.** Try out some of the materials as guides for research projects done by undergraduates in the Computer Law/Ethics/Society class. If feasible, use them with other target subpopulations, such as in other engineering courses or in computer law/ethics courses at other schools. Collect student evaluation information.

Summer 2008

Supervise the work of the legal intern, a student with library research skills and/or a student with multimedia development skills.

- **Whistleblowing.** Solicit feedback on the instructional support materials from attorneys and engineering practitioners. By this point at least one of the articles should have been published, attracting some attention in the engineering community.
- **Reverse engineering or penetration testing.** Complete the literature reviews and submit them. Probably, structure at least some of these as a debate. Probably, set the web site up for this topic as a debate support site (we anticipate strongly held differences of opinion and intend to capture and highlight the best statements of the differences).
- **Malpractice liability.** This is probably the main focus of the legal intern this summer. Complete at least one of the literature reviews and leave behind a structure that supports completion of research needed for the others.
- **Commercial liability.** Continue the incremental updating of the badsoftware site.
- **Conflicts of interest, constraints on reporting, IP rights and plagiarism in laboratory research.** Make progress on these areas as and if they capture the interest of one or more of the students.
- **Tutorials on legal research for engineers.** Hire a few short-term research assistants who will use the tutorials so far as guidance for updating the material on whistleblowing, reverse engineering (or penetration testing), malpractice liability and commercial liability. Collect detailed progress and confusion reports from these students.
- **Complete the Year 2 status report for NSF.**

Fall 2008-Summer 2009

I expect to have a system administrator and one or two research undergraduates on the project.

- **Whistleblowing.** Final updates as needed. Capture evaluations from instructors at other schools. Present the instructional approach and introduce the material at a conference on engineering education and/or in a journal focused on engineering education.
- **Reverse engineering or penetration testing.** Complete the suite of materials. Final updates as needed. Capture evaluations from instructors at other schools. Present the instructional approach and introduce the material at a conference on engineering education and/or in a journal focused on engineering education.
- **Malpractice liability.** Complete the suite of materials. Final updates as needed. Supplement the course materials with materials gathered from insurers and/or plaintiffs lawyers. Capture evaluations from instructors at other schools. Present the instructional approach and introduce the material at a conference on engineering education and/or in a journal focused on engineering education.
- **Commercial liability.** Continue the incremental updating of the badsoftware site. Complete the suite of course materials. Publish literature reviews and present a tutorial on teaching commercial law to engineering students at one of the engineering education conferences.
- **Conflicts of interest, constraints on reporting, IP rights and plagiarism in laboratory research.** Progress as appropriate.
- **Tutorials on legal research for engineers.** Continue extending and using these tutorials.
- **Complete the final report for NSF.**

ASSESSMENT PLAN

Behind all of our thinking about assessment lies the question of risk management. The risk that concerns us (Kaner, Ford, Tilley) most is the content risk. We are integrating legal, technological, ethical and instructional research into the materials we develop. We understand how to do this, in the sense that we have done it before and are confident that we can do it again. But our experience has taught us that this is painstaking, difficult work and that it will require us to aggressively stretch the minds of our students. We are particularly focused, in our risk management thinking, on the content risk because we think we understand the flow of projects (the project management risk) and the ways that we will draw others into collaborative assessment (the external verification of quality control risk):

- We have extensive project management experience—Kaner and Ford have both managed several industrial projects with large budgets, and all three of us have managed academic research projects at least as large as the one proposed here.
- We also expect that multi-institutional adoption and evaluation will come to the project naturally if we develop good enough material and publicize it well. For example, if it is good work, the whistleblowing materials will be noticed in presentations at the meetings of the American Law Institute committee on the Restatement of Employment Law (the Restatements are routinely treated as authoritative statements of the law by American appellate courts). Attorneys will provide critiques and suggestions whether we want them or not, if this work is good, because of the legal/societal impact that comes from influencing a Restatement. Similarly with the Black Box Software Testing course, instructional collaborators started approaching Kaner as soon as materials worth using were available and publicized on the web. Rather than investing time and resources to formalize collaborative relationships now, we believe the best way to manage risk on this project is to invest heavily in the first-version quality of the materials we produce and bring others into the project later, when we have credible material to entice them with.

Assessment of this project involves five key questions:

1. Is the work progressing as planned?
2. Is this teaching style effective?
3. Are the individual learning units useful and effective?
4. Do the research skills tutorials help students update the materials?
5. Are the materials available and are they being used?

I'll consider these in turn:

1. Is the work progressing as planned?

The development plan provides a first draft task list that we can measure progress against. We expect to start work on all of these topics but to narrow focus to the few that show particular promise.

We will have regular lab meetings (probably every two weeks) to review progress and will circulate status reports on a weekly basis. Each student who joins the project will be assigned to one of us as the student's supervisor. The supervisor and student will meet once each week, more often when necessary.

2. Is this teaching style effective?

This style is a straightforward extension of an approach that my students and I developed for the Black Box Software Testing course at <http://www.testingeducation.org/BBST>. Students in the BBST classes at Florida Tech review it well (we use the *Student Assessment of Learning Gains* at <http://www.wcer.wisc.edu/salgains/instructor/>), indicating that they work very hard in the course and get a lot out of it (Kaner & Fiedler, 2005a). I host a yahoogroups mailing list for people who teach from the course or self-study and want to help improve the course for that purpose. It currently has 200 members.

Faculty from several other universities use segments from the course as do in-house trainers and external trainers. In my most recent proposal to NSF related to this work (DUE: CCLI Curricular Support for Software Testing , still under review), several university faculty, corporations and consultant/trainers joined the proposal, signing a 3-page agreement to teach the course and help assess and improve it. This is a substantial amount of work, which these organizations agreed to donate to the project. Their willingness to make this commitment, after working with these materials, is a testimony to the quality of the materials.

The materials posted at the BBST site support a blended learning or online learning model. The video lectures, slides, papers—the content—are posted on the site. What is not captured on the site are the activities. At Florida Tech, we do the activities live, face-to-face. Students join an open source software development project (currently, Mozilla Firefox 2.0) and do labs and takehome projects applying the lecture material to this product under development. Students work in teams, get feedback from the instructor and each other, and report in their course evaluations that the projects make a significant contribution to their learning gains. I have not yet tried facilitating a purely online version of the course but expect to do so over the next year as do some of the collaborating organizations. In principle, these materials should provide good support for such a course. We will undoubtedly improve them in response to our experiences.

Everything that I have learned about this approach in BBST and will continue to learn (even if the CCLI proposal is not funded, we will do some of that work, albeit much less formally and at a slower pace) is directly applicable to this project but that learning is not proposed as part of this project.

In this project, we will evaluate the quality of the individual learning units from the baseline assumption that the underlying instructional approach is reasonably good.

3. Are the individual learning units useful and effective?

Professors Ford, Tilley and I will use the materials we develop in software engineering courses that we teach. We will collect *Student Assessment of Learning Gains* feedback from the students and will appraise student performance on exams, essays, and/or other assignments.

We will publish the course materials on MERLOT (<http://www.merlot.org>). This site publishes a large number of online, shareable learning units along and publishes peer reviews of many of them. It also invites comments from other MERLOT members. Some courses receive many comments, many receive none or almost none. We will also publish the learning units on a site of our own, with a discussion forum for critiquing the materials. Some of the sites that publish materials and invite critical discussion harvest very little discussion. I hope but cannot promise that we will get more than this.

MERLOT is one vehicle for advertising availability of these materials. We can advertise in other fora, such as the FASE (software engineering education) mailing list. The learning units that we create will be of significant quality and cover topics that aren't already readily available to instructors as pre-packaged add-ins for their courses. Given sufficient quality and publicity, I am confident that at least a few other instructors will adopt these materials and be willing to give us their experience reports.

Finally, the lectures are being developed on top of literature reviews and other written material that we intend to publish. Acceptance of these works is another indicator of quality.

4. Do the research skills tutorials help students update the materials?

In principle, the assessment task is straightforward: The student watches the video and does some activities intended to improve his or her legal research skills. Then s/he applies those skills to a topic that needs updating, perhaps writing an essay for the course, and we see how well the task was done.

A within-subjects comparison of pre-instructional and post-instructional performance would probably yield impressive differences. However, I think that thoughtfully wrestling with a problem once prepares

motivated students to wrestle more skillfully next time. Therefore, I would expect significant improvements on, for example, a second attempt to write a research paper (same topic or different, so long as the research skills and types of materials to be consulted are the same) with or without intervening instruction on research methods.

My experience with Florida Tech's graduate and undergraduate software engineering and computer science students is that their library research skills are weak and their knowledge of the legal sources is negligible. I base this on supervising essay writing and classroom research presentations in several undergraduate ethics courses and long discussions with my graduate students and students working in the labs of other faculty about ethical issues raised but inadequately researched in their thesis. Based on this experience, my assessment of the success of the research-skills materials will be easy. If the students demonstrate any skill at creating an update, the materials were successful.

I will of course ask students to fill out assessments of the material. I will also ask other ethics teachers and other attorneys to review the videos and other materials, filling out an evaluation form. Having reviewed materials for other people, I expect to be able to get feedback from at least a few (say, three, teachers and three lawyers or law professors).

As with the content-focused materials, the videos and demonstrations and exercises (etc.) for these research skills tutorials will also go online at our site and on MERLOT, with an invitation for peer review and a discussion list or wiki clearly available for feedback.

5. Are the materials available and are they being used?

Availability to us means both that the materials are posted on a reliable server with adequate bandwidth and that people are aware of them. Ensuring that the materials get to an adequate site is part of the core project plan. It will happen in the normal course of the project. With respect to visibility:

- We will check the listing of the site in search engines. If a topic posted on the site is not well-featured on a search engine, we will find ways to interest colleagues in the work enough that they will discuss it in mail messages and blogs, ultimately driving the visible popularity of the site high enough to improve visibility on Google (etc.)
- We will require users to log onto the course management system. The contact information will inform us of raw numbers as well as geographic and occupational diversity of our user community.

With respect to use, one measure is the number of users. Another weak measure is the extent of discussion of the learning units posted at our site. We will also see traffic on mailing lists that we create to support the individual learning units, but our experience with the black box software testing course is that such discussions are not particularly helpful for assessing the underlying material. The more important measure to us is the extent to which other instructors are interested in using and adapting the material.

RESULTS FROM PRIOR SUPPORT

I received NSF Award EIA-0113539 ITR/SY+PE: "Improving the Education of Software Testers" for \$469,668.00 for 36 months with an effective date of 09/01/01.

The most important work product from this grant is my black box testing course, at <http://www.testingeducation.org>. I transformed this from a highly successful commercial testing course into an academic one. Many of the other work products created under the grant served to generate material for this course or test assertions being made in the course. The current version includes about 40 lecture hours of video, over 600 lecture slides plus in-class exercises, assignments and study questions. The notes support about 80 lecture hours, including, among many topics, several testing techniques, test oracles, software development life cycles, test-related measurements, theory of measurement, estimating the size (labor cost) of testing tasks, bug reporting (including troubleshooting, description, stakeholder-

impact analysis, and configuration-management issues), and test-related career planning. This is more than anyone would cover in a single testing course. The variety helps the instructor customize the course to meet students' information preferences.

Another course, on programmer-testing, was also created (Tinkham & Kaner, 2005). This course focuses on techniques likely to be used by programmers testing their own code. Students come into the course knowing Java and knowing how to test. We teach them to be better programmers by applying tests at many levels while they design and write programs. We also teach them to be better testers by making them better testing toolsmiths and tool users. We study test-first programming using unit testing tools (JUnit integrated into Eclipse), white box integration test tools (Cunningham's Framework for Integrated Testing at <http://fit.c2.com/>) and testing through the application programmer interface. We don't have many lecture slides because the course is activity-based rather than lecture-based. Students work in groups through assignments, some of which are more defined by them than by the instructor, present their ideas, tests and code to the class and are coached by the instructor, the teaching assistant, and by other students.

Summary of several results and publications:

- Development of an extensive set of lecture slides for university teaching of a software testing course (Tinkham & Kaner, 2005);
- Development of a website, www.testingeducation.org, that provides educational materials under open licenses that allow reuse without fee by other instructors.(Kaner & Bond, 2004)
- Inclusion not just of our course notes, but notes from several other commercially successful testing teachers, open-licensed, at www.testingeducation.org/coursenotes.
- Creation of a failure mode catalog (bug taxonomy) for e-commerce applications (Vijayaraghavan, 2003; Vijayaraghavan & Kaner, 2002, 2003). (This won awards at two software testing conferences.
- Creation (in progress) of a failure mode catalog for wireless PDA applications (Jha & Kaner, 2003).
- Articles on test techniques and methods to supplement several lecture segments (Kaner, 2003g, 2003h, 2004h; Kaner, Bond, & McGee, 2004; McGee & Kaner, 2004; Padmanabhan, 2004; Singh, 2001; Tinkham & Kaner, 2003a, 2003b).
- Public discussions of the structure and goals of the testing courses (Kaner, 2001, 2003b, 2004a, 2004f, 2004h, 2004i, 2006; Kaner & Padmanabhan, 2006 submitted; Padmanabhan, 2004; Tinkham & Kaner, 2005). An example of interest for evaluating the quality of the work as a whole is Kaner (2003a) on assessment in the software testing course. The paper is a work in progress that lays out the underlying reasoning behind our assessment methods in the software testing course, gives plenty of examples of the types of questions and assignments we use, illustrates our approach to grading with worked examples, and discusses the problems that we've encountered (the traps students fall into and how we're modifying what we do to mitigate these without compromising our standards.
- Discussions of fundamental or controversial issues in software testing (Kaner, 2002a, 2003c, 2003e, 2003f, 2004b, 2004e; Kaner & Bach, 2002)
- Several conference tutorials (public teaching and review of material from or intended for the lecture notes) (Kaner, 2002a, 2002b, 2004f, (Kaner & Bach, 2003; Kaner & Fay, 2004)). See www.testingeducation.org for links to several example tutorials.
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- Kaner, C., & Padmanabhan, S. (2006 submitted). Practice and transfer of learning in the teaching of software testing, *36th Annual Frontiers in Education Conference*. San Diego, CA.
- Kaner, C., & Pels, D. L. (1998). *Bad Software: What To Do When Software Fails*. New York: Wiley.
- Lenzo, C. P. (2004). For whom the whistle blows: The haphazard patchwork of little-known federal statutes protecting whistleblowers in the private sector. Presented at the *American Bar Association Labor & Employment Law Section 2004 Mid-Winter Meeting*, Rancho Mirage, CA. Retrieved March 16, 2006. from <http://www.bna.com/bnabooks/ababna/eeo/2004/eeo222.pdf>.
- M.A. Mortenson Co. v. Timberline Software Corp., 998 P.2d 305 (Supreme Court of Washington 2000).
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- Online Ethics Center for Engineering and Science. (undated). Welcome to the Online Ethics Center for Engineering and Science. Retrieved March 16, 2006, from <http://onlineethics.org/>
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- Rinaldi v. Iomega Corp., 41 U.C.C. Rep. Serv. 2d (Callaghan) 1143 (Superior Court of Delaware, New Castle 1999).
- Samuelson, P., & Scotchmer, S. (2002). The Law and Economics of Reverse Engineering. *Yale Law Journal*, 111, 1575.
- Singh, A. (2001). *Test patterns*. Unpublished MS, Florida Institute of Technology, Melbourne, FL.
- Sony Computer Entertainment, Inc. v. Connectix Corp., 203 F.3d 596 (United States Court of Appeals for the Ninth Circuit 1999).
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- Tinkham, A., & Kaner, C. (2003a, May). Exploring Exploratory Testing. Presented at the *Software Testing Analysis & Review Conference (STAR) East*.
- Tinkham, A., & Kaner, C. (2003b, October, 2003). Learning styles and exploratory testing. Presented at the *Pacific Northwest Software Quality Conference*, Portland, OR. from [http://www.testingeducation.org/articles/ExploratoryTestingandLearningStyles\(Final\).pdf](http://www.testingeducation.org/articles/ExploratoryTestingandLearningStyles(Final).pdf)
- Tinkham, A., & Kaner, C. (2005). Experiences Teaching a Course in Programmer Testing. Presented at the *Agile 2005 Conference*, Denver, CO. Retrieved January 16, 2006. from <http://www.testingeducation.org/articles/ExperiencesTeachingTDD.pdf>.
- Vijayaraghavan, G. (2003). *A Taxonomy of E-Commerce Risks and Failures*. Unpublished Master's thesis, Florida Institute of Technology, Melbourne, FL. from http://www.testingeducation.org/articles/ecommerce_taxonomy.pdf
- Vijayaraghavan, G., & Kaner, C. (2002). Bugs in Your Shopping Cart: A Taxonomy. Presented at the *15th International Software Quality Conference (Quality Week)*.
- Vijayaraghavan, G., & Kaner, C. (2003, May). Bug Taxonomies: Use Them to Generate Better Tests. Presented at the *Software Testing Analysis & Review Conference (STAR) East*.
- Westman, D., P., & Modesitt, N. M. (2004, supplemented 2005). *Whistleblowing: The Law of Retaliatory Discharge* (Second ed.). Washington, DC: BNA Books: .

BIOGRAPHICAL SKETCH

BIOGRAPHICAL SKETCH – CEM KANER

a. Professional Preparation

| | | |
|------------------------------|--|------------|
| Brock University, Ontario | Arts & Sciences, primarily Math & Philosophy | B.A., 1974 |
| McMaster University, Ontario | Experimental Psychology | Ph.D. 1984 |
| Golden Gate University, CA | Law | J.D., 1994 |

b. Appointments

- Director, Center for Software Testing Education & Research, Florida Institute of Technology, November 2003–present.
- Professor of Software Engineering, Florida Institute of Technology, August 2000–present
- Extension Instructor, University of California Extension (Berkeley and Santa Cruz), 1994-2000
- Attorney, Law Office of Cem Kaner, 1994-present [My client list is private, but it doesn't include anyone relevant to this grant, other than people who are elsewhere listed as collaborators].
- Proprietor, kaner.com (software consulting), 1993-present [Representative clients: Avid Technologies, Autodesk, BEA Systems, BMC, Catalysis (through them, California Dept of Transportation), CDI, Compaq, Fenwick & West, Fonix, Hewlett-Packard, IDTS, Intel, Kodak, Microsoft, MyTurn.com, Oracle, OrCAD, Peoplesoft, PowerQuest, Safeco, Satisfice, ShareData (now E-Trade), Software AG, Software Quality Engineering, Stevedoring Services of America, the WELL, and Wind River]
- Deputy District Attorney (full-time volunteer), Santa Clara County, April 1994-July 1994.
- Law Clerk, Law Office of Berne Reuben, Dec. 1993-April 1994.
- Director of Documentation and Software Testing; Documentation Group Manager; Software Development Manager, Power Up Software (later Spinnaker Software), 1989-1994.
- Software Test Manager, Electronic Arts, 1988
- Human Factors Analyst / Software Engineer, Telenova, Inc, 1984-1988.
- Testing Technology Team Leader; Software Testing Supervisor, MicroPro (WordStar), 1983-1984.
- Associate (and then Senior Associate) (part-time), Psylomar Organization Development, 1983-1985.

c. Publications

c.(i) Most closely related

- Cem Kaner, "Software engineering & UCITA." *John Marshall Journal of Computer & Information Law*. 18(2), 435-546, 1999. <http://www.kaner.com/pdfs/engr2000.pdf>
- Cem Kaner & David Pels, *Bad Software: What to do When Software Fails*, John Wiley & Sons.
- Andy Tinkham & Cem Kaner, Experiences teaching a course in programmer testing. *Agile 2005 Conference*, Denver, CO, July 2005. <http://www.testingeducation.org/articles/ExperiencesTeachingTDD.pdf>
- Cem Kaner & Rebecca Fiedler, Blended learning: A software testing course makeover. *11th Sloan-C International Conference on Asynchronous Learning Networks*, Orlando, FL, November 2005. <http://www.ce.ucf.edu/asp/aln/2005sessions/presentations/1129300092852.pdf>
- Cem Kaner, "Issues in commercial law of interest to software engineering educators." (Tutorial session.) *Conference on Software Engineering Education & Training*, Cincinnati OH, February 2002.
- Cem Kaner, "The proposed Florida Tech stored course policy." *Computer Graphics*, 36(2), 15-17, 21-22, 2002. <http://www.siggraph.org/pub-policy/CGColumn-05-2002.html>

c.(ii) Other significant publications

- Cem Kaner, James Bach & Bret Pettichord, *Lessons Learned in Software Testing*. Wiley, 2002.
- Cem Kaner, Jack Falk & Hung Quoc Nguyen, *Testing Computer Software* (2nd Ed.), Wiley, 1993.
- Cem Kaner, " Software engineering metrics: What do they measure and how do we know?," *10th International Software Metrics Symposium (METRICS 2004)*, Chicago, IL. September 2004, <http://swmetrics.mockus.us/metrics2004/lbp/KanerBond.pdf>
- Giri Vijayaraghavan & Cem Kaner, "Bugs in your shopping cart: A taxonomy," *15th International Software Quality Week*. San Francisco, CA, September 2002. <http://www.kaner.com/pdfs/BugsInYourShoppingCart.pdf>. (Received Best Paper award).

d. Synergistic Activities

Editor of the *Journal of the Association for Software Testing*, the journal of a new professional society for software testers.

Co-organizer of several ongoing workshops, including the Los Altos Workshops on Software Testing, the Software Test Managers Roundtable, the Workshop on Heuristic and Exploratory Techniques, the Florida Workshops on Model-Based Software Test Automation, the Austin Workshop on Test Automation, the Mountain Enterprise Testing Roundtable, and the Workshop on the Teaching of Software Testing.

Elected to the American Law Institute, May, 1999. One of the most prestigious organizations of attorneys in the country, memberships are life-long and the Institute's total membership is limited to 3000. This organization drafts legislation, treaties, and the Restatements (of Torts, Products Liability, Agency, Contracts, etc.), a series of authoritative treaties that are heavily relied on by appellate judges. I was elected in recognition of my legislative work on computer law. My primary current work with this group is on the *Restatement of Employment Law*.

e. Collaborators and Other Affiliations

e.(i) Collaborators: James Bach (Satisfice Inc), Shirley Becker (Florida Tech), Walter P. Bond (Florida Tech), Jean Braucher (University of Arizona), Jennifer Brock (ADP), Hans Buwalda (CMG), Phil Chan (Florida Tech), Ross Collard (independent), Ward Cunningham (Microsoft), Ed Foster (InfoWorld), David Gelperin (SQE), Jens Gregor (U. Tennessee), Sam Guckenheimer (IBM), Elisabeth Hendrickson (Quality Tree Consulting), Doug Hoffman (Software Development Technologies), Allen Johnson (Huston-Tillotson College), Bob Johnson (Agorics), Mark Johnson (Cadence), Alan Jorgensen (Florida Tech), Phil Koopman (Carnegie Mellon University), Richard Kopec (St.Edwards University), Brian Lawrence (Coyote Valley Software), James Love (Consumer Project on Technology), Brian Marick (University of Illinois, Urbana-Champaign), Gerald Marin (Florida Tech), Fran McKain (Hewlett-Packard), David McMahon (attorney), Renaldo Menezes (Florida Tech), Mark Minasi (independent journalist), Debasis Mitra (Florida Tech), Hung Quoc Nguyen (LogiGear Technologies), David Pels (independent), Bret Pettichord (pettichord.com), David Rice (University of Rhodes Island, Law School), Sharon Roberts (Roberts consulting; Independent Computer Consultants Association), Johanna Rothman (Johanna Rothman Consulting), Patrick Schroeder (Milwaukee School of Engineering), William Shoaff (Florida Tech), Marius Silaghi (Florida Tech), Scott Tilley (Florida Tech), Michael Thomason (U. Tennessee), James Tierney (Microsoft), Tim Van Tongren (MCI), James Whittaker (Florida Tech).

e.(ii) Graduate and Post Doctoral Advisors. A.B. Kristofferson (retired), John R. Platt (McMaster U.), Woody Heron (retired), Ibrahim Ahmad (Mathematics, McMaster U.), Roger Bernhardt (Golden Gate U. Law School).

e.(iii) Thesis Advisor and Postgraduate-Scholar Sponsor: Turkey Al-Otaiby, Ibrahim El-Far, Sabrina Fay, Saurabh Gupta, Jia Hui Liu, James Patrick McGee, Sowmya Padmanabhan, Sujit Raghavan, Amit Singh, Andy Tinkham, Giri Vijayaraghavan, (all at Florida Tech.).

BIOGRAPHICAL SKETCH

BIOGRAPHICAL SKETCH – RICHARD FORD

a. Professional Preparation

| | | |
|---|---------|--------------------|
| The Queen's College, University of Oxford | Physics | BA Hons Oxon, 1989 |
| The Queen's College, University of Oxford | Physics | D.Phil., 1992 |

b. Appointments

- Acting Director, Institute for Computing and Information Systems, Florida Institute of Technology, 2005-date
- Associate Professor of Computer Science, Florida Institute of Technology, 2005-date
- Research Professor, Dept. of Computer Sciences, Florida Institute of Technology, 2003-2005
- Consultant, The Rock Ventures 2002-2003
- Chief Technology Officer, Cenetec LLC, 2000-2002
- Director of Engineering, Hiway Technologies/Verio 1998-2000
- Researcher, IBM Research T.J. Watson Laboratories, 1997-1998
- Director of Technology, Command Software Systems 1995-1997
- Director of Research, National Computer Security Associate, 1994-1995
- Editor, Virus Bulletin 1992-1994

c. Publications

c.(i) Most closely related

Ford R., Bush M., and Boulatov A., *Internet Instability and Disturbance: Goal or Menace?* Accepted for publication at New Security Paradigms Workshop (2005)

Menezes R., Ford R., and Ondi A., *Swarming Computer Security: An Experiment in Policy Distribution*, Proceedings of the 2005 IEEE Swarm Intelligence Symposium, pp.436-439, IEEE Press (2005)

Gordon S., and Ford R., *Cyberterrorism?*, in *Cyberterrorism*, The International Library of Essays in Terrorism, Alan O'Day, Ashgate, ISBN 0 7546 2426 9 (2004)

Ford R., *The Future of Virus Detection*, Internet Security Technical Report, Vol. 9, No. 2, ISSN 1363-4127, Elsevier

Thompson H.H., and Ford R., *Perfect Storm: The insider, naivety and hostility*. ACM Queue, 2(4):58-65, June 2004

c.(ii) Other significant publications

El Far I., Ford R., Ondi A., and Pancholi M., *On the Impact of Short-Term Email Message Recall on the Spread of Malware*, EICAR 2005 Conference Best Paper Proceedings, pp.178-189, ISBN 87-987271-7-6 (2005)

Chess, D., Ford R., Kephart J. and Swimmer M., *System and Method for Detecting and Repairing Document-infecting Viruses using Dynamic Heuristics*, US Patent 6,711,583, issued March 23rd, 2004

Ford R., *The Wrong Stuff*, IEEE Security & Privacy, 2(3):86-89, May/June 2004

Ford R., and Thompson H.H., *The Future of Proactive Virus Detection*, Proceedings of the EICAR Conference, Luxembourg 2004

Gordon, S. and Ford, R., *Cyberterrorism?*. Computers and Security. Elsevier Science Publications. Vol. 21, 7. pp. 636-647. ISSN 0167-4048 (2002)

Incompressible Electron Liquid States Studied by Optical Spectroscopy. Turberfield A.J., Ford R.A., Harris I.N., Ryan J.F., Foxon C.T., and Harris J.J. Phys. Rev. B., 47, pp.4794-4797 (1993)

d. Synergistic Activities

Senior Editor, Reed-Elsevier Science “Computers and Security”

Co-editor of Basic Training Column with Michael Howard, IEEE Security & Privacy

Executive Editor, Virus Bulletin, the most well-known journal on computer viruses and malicious mobile code

Active expert witness for the US Dept. of Justice and other civil attorneys.

Program Committee and Scientific Advisor for the European Institute for Computer Antivirus Research (EICAR)

Founding board member and User Ombudsman for the WildList Organization International.

e. Collaborators and Other Affiliations

e.(i) Collaborators: William Allen (Florida Institute of Technology), Mark Bush (Florida Institute of Technology), Ibrahim El. Far (Microsoft), Sarah Gordon (Symantec), Jens Gregor (University of Tennessee Knoxville), Gerald Marin (Florida Institute of Technology), Ronaldo Menezes (Florida Institute of Technology), Helayne Ray (Security Innovation), Herbert H. Thompson (Security Innovation), Scott Tilley (Florida Institute of Technology), Matt Wagner (Microsoft), James Whittaker (Florida Tech.)

e.(ii) Thesis Advisor: R.G. Clark, University of Oxford, UK

Biographical Sketch

A. PROFESSIONAL PREPARATION

Scott Tilley is an Associate Professor of Software Engineering in the Department of Computer Sciences, and an Associate Professor of Management Information Systems in the College of Business, at the Florida Institute of Technology. He is also a Visiting Scientist at Carnegie Mellon University's Software Engineering Institute. He is Chair of the Steering Committee for the IEEE Web Site Evolution (WSE) series of events, Co-Chair of the SDM-DS Editorial Board, and the Immediate Past Chair of the Association for Computing Machinery's Special Interest Group on Design of Communication (ACM SIGDOC).



CONTACT INFORMATION

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Fax: +1 (316) 223-4218
Email: stilley@cs.fit.edu
Web: www.cs.fit.edu/~stilley

RESEARCH INTERESTS

Software engineering in general, and system evolution in particular. Topic areas include program redocumentation, reverse engineering for program understanding, net-centric computing, technology adoption, end-user programming, hypermedia, intellectual property, and Web site evolution.

TEACHING INTERESTS

Software construction, software engineering, software maintenance & evolution, multimedia technologies and programming, senior design projects, information systems, Web site construction.

EDUCATION

- | | | | |
|--------------------------|------------------------------------|-------------|------|
| ▪ Concordia University | Computer Science (Digital Systems) | B.Comp.Sci. | 1986 |
| ▪ University of Victoria | Computer Science | M.Sc. | 1989 |
| ▪ University of Victoria | Computer Science | Ph.D. | 1995 |

B. APPOINTMENTS

- | | |
|----------------|--|
| 2003 – present | Florida Institute of Technology <ul style="list-style-type: none">▪ Associate Professor of Software Engineering, Department of Computer Sciences▪ Associate Professor of Management Information Systems, College of Business (joint appointment, 2006 – present) |
| 1998 – 2002 | University of California, Riverside <ul style="list-style-type: none">▪ Assistant Professor, Department of Computer Science & Engineering▪ Collaborating Faculty Member, School of Management (2000 – 2002) |
| 1995 – present | Carnegie Mellon University, Software Engineering Institute <ul style="list-style-type: none">▪ Visiting Scientist, Integration of Software-Intensive Systems (2006 – present)▪ Visiting Scientist, Product Line Systems (1998 – 2002)▪ Senior Member of the Technical Staff, Reengineering Center (1995 – 1998) |
| 1987 – 1994 | IBM Software Solutions Toronto Laboratory Senior Associate Development Analyst, C/C++ Compiler Development |

C. PUBLICATIONS

CLOSELY RELATED TO THE PROJECT

1. Tilley, S.; Distanto, D.; and Huang, S. “Design Recovery of Web Application Transactions.” In *Advances in Software Evolution with UML and XML* (Editor: Hongji Yang). Hershey, PA: Idea Group Publishing, 2005.
2. Kienle, H.; German, D.; Tilley, S.; and Müller, H. “Intellectual Property Aspects of Web Publishing.” *Proceedings of the 22nd ACM International Conference on Design of Communication* (SIGDOC 2004: October 10-13, 2004; Memphis, TN), pp. 136-144. NY, NY: ACM Press, 2004.
3. Müller, H.; Jahnke, J.; Smith, D.; Storey, M.-A.; Tilley, S.; and Wong, K. “Reverse Engineering: A Roadmap.” In *The Future of Software Engineering* (Editor: Anthony Finkelstein), pp. 47—60. New York, NY: ACM Press, 2000.

SIGNIFICANT OTHER PUBLICATIONS

1. Distanto, D.; Tilley, S.; Canfora, G.; and Huang, S. “Redesigning Legacy Applications for the Web with UWAT+: A Case Study.” To appear in *Proceedings of the 28th International Conference on Software Engineering* (ICSE 2006: May 20-28, 2006; Shanghai, China). Los Alamitos, CA: IEEE CS Press, 2006.
2. Tilley, S.; Gerdes, J.; Hamilton, T.; Huang, S.; Müller, H.; Smith, D.; and Wong, K. “On the Business Value and Technical Challenges of Adopting Web Services.” *Journal of Software Maintenance and Evolution: Research and Practice*, 16:31-50. John Wiley & Sons, 2004.
3. Tilley, S. “The Canonical Activities of Reverse Engineering.” *Annals of Software Engineering* 9:249-271. Baltzer Scientific / Kluwer Academic, 2000.

D. SYNERGISTIC ACTIVITIES

- **Board Membership:** Immediate Past Chair, ACM SIGDOC (2003 – 2005); Co-Chair, SDM-DS Steering Committee (2004 – present); Chair, IEEE WSE Steering Committee (2002 – present).
- **Conference Leadership:** General Co-Chair, *The 24th IEEE International Conference on Software Maintenance* (ICSM 2008: Sept. 16-20, 2008; Beijing, China); Finance Chair, *The 8th IEEE International Symposium on Web Site Evolution* (WSE 2006: Sept. 23-25, 2006; Philadelphia, PA); General Chair, *The 23rd ACM International Conference on Design of Communication* (SIGDOC 2005: Sept. 21-23, 2005; Coventry, UK).
- **Fellowships and Honors:** Regent’s Faculty Fellow, University of California (1999, 2001); IBM Faculty Award Recipient (2005-2006).

E. COLLABORATORS & OTHER AFFILIATIONS

COLLABORATORS AND CO-EDITORS

Above co-authors; J. Hartmann (BMW), T. Payne (Univ. of Calif., Riverside); A. Brown, R. Pierce, S. Murphy (IBM); E. Morris, L. Northrop (CMU/SEI), T. Parveen (FIT), Z. Zhiying (Tsinghua), ...

GRADUATE AND POSTDOCTORAL ADVISORS

Hausi Müller, University of Victoria

THESIS ADVISOR AND POSTGRADUATE-SCHOLAR SPONSOR

Tauhida Parveen (Florida Institute of Technology), Damiano Distanto (University of Lecce, Italy), Shihong Huang (Univ. of Calif., Riverside), Mohan DeSouza (Univ. of Calif., Riverside).

SUMMARY PROPOSAL BUDGET YEAR 1

| ORGANIZATION Florida Institute of Technology | | | | FOR NSF USE ONLY | | |
|---|--|--------------|--------------------|---------------------------------|--------------------------|--------------|
| | | | | PROPOSAL NO. | DURATION (months) | |
| PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR Cem Kaner | | | | AWARD NO. | Proposed | Granted |
| | | | | | NSF Funded Person-months | |
| A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets) | | | | CAL | ACAD | SUMR |
| 1. Cem Kaner - Principal Investigator | | | | 2.00 | 0.00 | 0.00 |
| 2. Richard A Ford - Senior Personnel | | | | 2.00 | 0.00 | 0.00 |
| 3. Scott R Tilley - Senior Personnel | | | | 2.00 | 0.00 | 0.00 |
| 4. | | | | | | |
| 5. | | | | | | |
| 6. (0) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE) | | | | 0.00 | 0.00 | 0.00 |
| 7. (3) TOTAL SENIOR PERSONNEL (1 - 6) | | | | 6.00 | 0.00 | 0.00 |
| B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS) | | | | | | |
| 1. (0) POST DOCTORAL ASSOCIATES | | | | 0.00 | 0.00 | 0.00 |
| 2. (0) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.) | | | | 0.00 | 0.00 | 0.00 |
| 3. (1) GRADUATE STUDENTS | | | | | | 11,000 |
| 4. (1) UNDERGRADUATE STUDENTS | | | | | | 9,120 |
| 5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY) | | | | | | 0 |
| 6. (0) OTHER | | | | | | 10,000 |
| TOTAL SALARIES AND WAGES (A + B) | | | | | | 45,120 |
| C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS) | | | | | | 3,945 |
| TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C) | | | | | | 49,065 |
| D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING \$5,000.) | | | | | | |
| Equipment | | | | \$ | 2,200 | |
| TOTAL EQUIPMENT | | | | | | 2,200 |
| E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS) | | | | | | 3,600 |
| 2. FOREIGN | | | | | | 0 |
| F. PARTICIPANT SUPPORT COSTS | | | | | | |
| 1. STIPENDS \$ _____ | | | | 0 | | |
| 2. TRAVEL _____ | | | | 0 | | |
| 3. SUBSISTENCE _____ | | | | 0 | | |
| 4. OTHER _____ | | | | 0 | | |
| TOTAL NUMBER OF PARTICIPANTS (0) TOTAL PARTICIPANT COSTS | | | | | | 0 |
| G. OTHER DIRECT COSTS | | | | | | |
| 1. MATERIALS AND SUPPLIES | | | | | | 2,000 |
| 2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION | | | | | | 8,000 |
| 3. CONSULTANT SERVICES | | | | | | 0 |
| 4. COMPUTER SERVICES | | | | | | 0 |
| 5. SUBAWARDS | | | | | | 0 |
| 6. OTHER | | | | | | 0 |
| TOTAL OTHER DIRECT COSTS | | | | | | 10,000 |
| H. TOTAL DIRECT COSTS (A THROUGH G) | | | | | | 64,865 |
| I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) | | | | | | |
| Fringe (Rate: 43.5000, Base: 3945) (Cont. on Comments Page) | | | | | | |
| TOTAL INDIRECT COSTS (F&A) | | | | | | 14,157 |
| J. TOTAL DIRECT AND INDIRECT COSTS (H + I) | | | | | | 79,022 |
| K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS SEE GPG II.C.6.j.) | | | | | | 0 |
| L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K) | | | | | | \$ 79,022 \$ |
| M. COST SHARING PROPOSED LEVEL \$ 0 | | | | AGREED LEVEL IF DIFFERENT \$ | | |
| PI/PD NAME Cem Kaner | | | | FOR NSF USE ONLY | | |
| ORG. REP. NAME* Deb Hartegan | | | | INDIRECT COST RATE VERIFICATION | | |
| | | Date Checked | Date Of Rate Sheet | Initials - ORG | | |

SUMMARY PROPOSAL BUDGET COMMENTS - Year 1

**** I- Indirect Costs**

Principal Investigator & Senior Personnel (Rate: 43.5000, Base 15000)

Publications (Rate: 43.5000, Base 8000)

Supplies (Rate: 43.5000, Base 2000)

Travel (Rate: 43.5000, Base 3600)

SUMMARY PROPOSAL BUDGET

YEAR 2

| ORGANIZATION Florida Institute of Technology | | | | FOR NSF USE ONLY | | | | |
|---|--|--------------|--|---------------------------------|-------------------|----------------|-----------------------------|-------------------------------------|
| | | | | PROPOSAL NO. | DURATION (months) | | | |
| PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR Cem Kaner | | | | AWARD NO. | | | | |
| A. SENIOR PERSONNEL: PI/PP, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets) | | | | NSF Funded Person-months | | | Funds Requested By proposer | Funds granted by NSF (if different) |
| | | | | CAL | ACAD | SUMR | | |
| 1. Cem Kaner - Principal Investigator | | | | 2.00 | 0.00 | 0.00 | \$ 5,000 | \$ |
| 2. Richard A Ford - Senior Personnel | | | | 2.00 | 0.00 | 0.00 | 5,000 | |
| 3. Scott R Tilley - Senior Personnel | | | | 2.00 | 0.00 | 0.00 | 5,000 | |
| 4. | | | | | | | | |
| 5. | | | | | | | | |
| 6. (0) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE) | | | | 0.00 | 0.00 | 0.00 | 0 | |
| 7. (3) TOTAL SENIOR PERSONNEL (1 - 6) | | | | 6.00 | 0.00 | 0.00 | 15,000 | |
| B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS) | | | | | | | | |
| 1. (0) POST DOCTORAL ASSOCIATES | | | | 0.00 | 0.00 | 0.00 | 0 | |
| 2. (0) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.) | | | | 0.00 | 0.00 | 0.00 | 0 | |
| 3. (2) GRADUATE STUDENTS | | | | | | | 17,600 | |
| 4. (2) UNDERGRADUATE STUDENTS | | | | | | | 23,520 | |
| 5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY) | | | | | | | 0 | |
| 6. (0) OTHER | | | | | | | 10,000 | |
| TOTAL SALARIES AND WAGES (A + B) | | | | | | | 66,120 | |
| C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS) | | | | | | | 3,945 | |
| TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C) | | | | | | | 70,065 | |
| D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING \$5,000.) | | | | | | | | |
| Equipment | | | | | \$ | 2,200 | | |
| TOTAL EQUIPMENT | | | | | | | 2,200 | |
| E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS) | | | | | | | 3,600 | |
| 2. FOREIGN | | | | | | | 0 | |
| F. PARTICIPANT SUPPORT COSTS | | | | | | | | |
| 1. STIPENDS \$ _____ | | | | 0 | | | | |
| 2. TRAVEL _____ | | | | 0 | | | | |
| 3. SUBSISTENCE _____ | | | | 0 | | | | |
| 4. OTHER _____ | | | | 0 | | | | |
| TOTAL NUMBER OF PARTICIPANTS (0) TOTAL PARTICIPANT COSTS | | | | | | | 0 | |
| G. OTHER DIRECT COSTS | | | | | | | | |
| 1. MATERIALS AND SUPPLIES | | | | | | | 2,000 | |
| 2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION | | | | | | | 8,000 | |
| 3. CONSULTANT SERVICES | | | | | | | 0 | |
| 4. COMPUTER SERVICES | | | | | | | 0 | |
| 5. SUBAWARDS | | | | | | | 0 | |
| 6. OTHER | | | | | | | 0 | |
| TOTAL OTHER DIRECT COSTS | | | | | | | 10,000 | |
| H. TOTAL DIRECT COSTS (A THROUGH G) | | | | | | | 85,865 | |
| I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) | | | | | | | | |
| Fringe (Rate: 43.5000, Base: 3945) (Cont. on Comments Page) | | | | | | | | |
| TOTAL INDIRECT COSTS (F&A) | | | | | | | 14,157 | |
| J. TOTAL DIRECT AND INDIRECT COSTS (H + I) | | | | | | | 100,022 | |
| K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS SEE GPG II.C.6.j.) | | | | | | | 0 | |
| L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K) | | | | | | | \$ 100,022 | \$ |
| M. COST SHARING PROPOSED LEVEL \$ 0 | | | | AGREED LEVEL IF DIFFERENT \$ | | | | |
| PI/PP NAME Cem Kaner | | | | FOR NSF USE ONLY | | | | |
| ORG. REP. NAME* Deb Hartegan | | | | INDIRECT COST RATE VERIFICATION | | | | |
| | | Date Checked | | Date Of Rate Sheet | | Initials - ORG | | |

SUMMARY PROPOSAL BUDGET COMMENTS - Year 2

**** I- Indirect Costs**

Principal Investigator (Rate: 43.5000, Base 15000)

Publications (Rate: 43.5000, Base 8000)

Supplies (Rate: 43.5000, Base 2000)

Travel (Rate: 43.5000, Base 3600)

SUMMARY PROPOSAL BUDGET YEAR 3

| ORGANIZATION Florida Institute of Technology | | | | FOR NSF USE ONLY | | | | |
|---|--|--------------|--------------------|---------------------------------|-------------------|-------|-----------------------------|-------------------------------------|
| | | | | PROPOSAL NO. | DURATION (months) | | | |
| PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR Cem Kaner | | | | AWARD NO. | | | | |
| A. SENIOR PERSONNEL: PI/PI, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets) | | | | NSF Funded Person-months | | | Funds Requested By proposer | Funds granted by NSF (if different) |
| | | | | CAL | ACAD | SUMR | | |
| 1. Cem Kaner - Principal Investigator | | | | 2.00 | 0.00 | 0.00 | \$ 5,000 | \$ |
| 2. Richard A Ford - Senior Personnel | | | | 2.00 | 0.00 | 0.00 | 5,000 | |
| 3. Scott R Tilley - Senior Personnel | | | | 2.00 | 0.00 | 0.00 | 5,000 | |
| 4. | | | | | | | | |
| 5. | | | | | | | | |
| 6. (0) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE) | | | | 0.00 | 0.00 | 0.00 | 0 | |
| 7. (3) TOTAL SENIOR PERSONNEL (1 - 6) | | | | 6.00 | 0.00 | 0.00 | 15,000 | |
| B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS) | | | | | | | | |
| 1. (0) POST DOCTORAL ASSOCIATES | | | | 0.00 | 0.00 | 0.00 | 0 | |
| 2. (0) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.) | | | | 0.00 | 0.00 | 0.00 | 0 | |
| 3. (1) GRADUATE STUDENTS | | | | | | | 6,600 | |
| 4. (2) UNDERGRADUATE STUDENTS | | | | | | | 23,520 | |
| 5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY) | | | | | | | 0 | |
| 6. (0) OTHER | | | | | | | 10,000 | |
| TOTAL SALARIES AND WAGES (A + B) | | | | | | | 55,120 | |
| C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS) | | | | | | | 3,945 | |
| TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C) | | | | | | | 59,065 | |
| D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING \$5,000.) | | | | | | | | |
| Equipment | | | | | \$ | 2,200 | | |
| TOTAL EQUIPMENT | | | | | | | 2,200 | |
| E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS) | | | | | | | 3,600 | |
| 2. FOREIGN | | | | | | | 0 | |
| F. PARTICIPANT SUPPORT COSTS | | | | | | | | |
| 1. STIPENDS \$ _____ | | | | 0 | | | | |
| 2. TRAVEL _____ | | | | 0 | | | | |
| 3. SUBSISTENCE _____ | | | | 0 | | | | |
| 4. OTHER _____ | | | | 0 | | | | |
| TOTAL NUMBER OF PARTICIPANTS (0) TOTAL PARTICIPANT COSTS | | | | | | | 0 | |
| G. OTHER DIRECT COSTS | | | | | | | | |
| 1. MATERIALS AND SUPPLIES | | | | | | | 2,000 | |
| 2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION | | | | | | | 8,000 | |
| 3. CONSULTANT SERVICES | | | | | | | 0 | |
| 4. COMPUTER SERVICES | | | | | | | 0 | |
| 5. SUBAWARDS | | | | | | | 0 | |
| 6. OTHER | | | | | | | 0 | |
| TOTAL OTHER DIRECT COSTS | | | | | | | 10,000 | |
| H. TOTAL DIRECT COSTS (A THROUGH G) | | | | | | | 74,865 | |
| I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) | | | | | | | | |
| Fringe (Rate: 43.5000, Base: 3945) (Cont. on Comments Page) | | | | | | | | |
| TOTAL INDIRECT COSTS (F&A) | | | | | | | 14,157 | |
| J. TOTAL DIRECT AND INDIRECT COSTS (H + I) | | | | | | | 89,022 | |
| K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS SEE GPG II.C.6.j.) | | | | | | | 0 | |
| L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K) | | | | | | | \$ 89,022 | \$ |
| M. COST SHARING PROPOSED LEVEL \$ 0 | | | | AGREED LEVEL IF DIFFERENT \$ | | | | |
| PI/PI NAME Cem Kaner | | | | FOR NSF USE ONLY | | | | |
| ORG. REP. NAME* Deb Hartegan | | | | INDIRECT COST RATE VERIFICATION | | | | |
| | | Date Checked | Date Of Rate Sheet | Initials - ORG | | | | |

SUMMARY PROPOSAL BUDGET COMMENTS - Year 3

**** I- Indirect Costs**

Principal Investigator (Rate: 43.5000, Base 15000)

Publications (Rate: 43.5000, Base 8000)

Supplies (Rate: 43.5000, Base 2000)

Travel (Rate: 43.5000, Base 3600)

SUMMARY PROPOSAL BUDGET Cumulative

| ORGANIZATION Florida Institute of Technology | | | | FOR NSF USE ONLY | | | |
|---|-------|--------------|--------------------|---------------------------------|-------------------|-----------------------------|-------------------------------------|
| | | | | PROPOSAL NO. | DURATION (months) | | |
| PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR Cem Kaner | | | | AWARD NO. | Proposed | Granted | |
| A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets) | | | | NSF Funded Person-months | | Funds Requested By proposer | Funds granted by NSF (if different) |
| | CAL | ACAD | SUMR | | | | |
| 1. Cem Kaner - Principal Investigator | 6.00 | 0.00 | 0.00 | \$ 15,000 | | | |
| 2. Richard A Ford - Senior Personnel | 6.00 | 0.00 | 0.00 | 15,000 | | | |
| 3. Scott R Tilley - Senior Personnel | 6.00 | 0.00 | 0.00 | 15,000 | | | |
| 4. | | | | | | | |
| 5. | | | | | | | |
| 6. () OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE) | 0.00 | 0.00 | 0.00 | 0 | | | |
| 7. (3) TOTAL SENIOR PERSONNEL (1 - 6) | 18.00 | 0.00 | 0.00 | 45,000 | | | |
| B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS) | | | | | | | |
| 1. (0) POST DOCTORAL ASSOCIATES | 0.00 | 0.00 | 0.00 | 0 | | | |
| 2. (0) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.) | 0.00 | 0.00 | 0.00 | 0 | | | |
| 3. (4) GRADUATE STUDENTS | | | | 35,200 | | | |
| 4. (5) UNDERGRADUATE STUDENTS | | | | 56,160 | | | |
| 5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY) | | | | 0 | | | |
| 6. (0) OTHER | | | | 30,000 | | | |
| TOTAL SALARIES AND WAGES (A + B) | | | | | 166,360 | | |
| C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS) | | | | | 11,835 | | |
| TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C) | | | | | 178,195 | | |
| D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING \$5,000.) | | | | \$ 6,600 | | | |
| TOTAL EQUIPMENT | | | | | 6,600 | | |
| E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS) | | | | | 10,800 | | |
| 2. FOREIGN | | | | | 0 | | |
| F. PARTICIPANT SUPPORT COSTS | | | | | | | |
| 1. STIPENDS \$ _____ | | | 0 | | | | |
| 2. TRAVEL _____ | | | 0 | | | | |
| 3. SUBSISTENCE _____ | | | 0 | | | | |
| 4. OTHER _____ | | | 0 | | | | |
| TOTAL NUMBER OF PARTICIPANTS (0) | | | | TOTAL PARTICIPANT COSTS | 0 | | |
| G. OTHER DIRECT COSTS | | | | | | | |
| 1. MATERIALS AND SUPPLIES | | | | | 6,000 | | |
| 2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION | | | | | 24,000 | | |
| 3. CONSULTANT SERVICES | | | | | 0 | | |
| 4. COMPUTER SERVICES | | | | | 0 | | |
| 5. SUBAWARDS | | | | | 0 | | |
| 6. OTHER | | | | | 0 | | |
| TOTAL OTHER DIRECT COSTS | | | | | 30,000 | | |
| H. TOTAL DIRECT COSTS (A THROUGH G) | | | | | 225,595 | | |
| I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) | | | | | | | |
| TOTAL INDIRECT COSTS (F&A) | | | | | 42,471 | | |
| J. TOTAL DIRECT AND INDIRECT COSTS (H + I) | | | | | 268,066 | | |
| K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS SEE GPG II.C.6.j.) | | | | | 0 | | |
| L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K) | | | | | \$ 268,066 | \$ | |
| M. COST SHARING PROPOSED LEVEL \$ 0 | | | | AGREED LEVEL IF DIFFERENT \$ | | | |
| PI/PD NAME Cem Kaner | | | | FOR NSF USE ONLY | | | |
| ORG. REP. NAME* Deb Hartegan | | | | INDIRECT COST RATE VERIFICATION | | | |
| | | Date Checked | Date Of Rate Sheet | Initials - ORG | | | |

C *ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

EESE: Learning Units on Law and Ethics in Software Engineering

Budget Justification

Senior Personnel:

The allocation is \$5000 per investigator (Kaner, Tilley, Ford) as summer support. This amount is substantially less than one month's pay for any of us and it will not fully compensate us for our time on this project. We have discussed this at length and agreed to commit to donating the extra time necessary to carry out the project.

Other Personnel:

We will bring two law students to the project as summer interns. At \$25 per hour (the low side of what we believe is needed to attract good law students), a summer's work costs \$11,000. The budget assumes one student in summer 2007, one in summer 2008.

We will bring hire two other summer students who can develop instructional material that teaches engineers how to use legal research materials. Probably, these will be information science or library science students. At \$15 per hour, these students will cost \$6600 each. The budget shows them as graduate students, one in the summer of 2008, one the summer of 2009.

We will hire several undergraduate research assistants at \$12 per hour for 20 hours per week (38 weeks) during the academic year. We also expect to employ one of these students in summer 2008 and one in summer 2009. These students will serve as system administrators for the course website, video production/editing technicians, and content researchers/writers. We expect to employ one student in academic 2006-2007, two in 2007-2008, and two in 2008-2009.

We also budget \$10,000 per year for tuition support, to be spread among the graduate and undergraduate research assistants as appropriate. This is a small fraction of the tuition these students will actually pay, but many of these students will have other scholarships.

Equipment

The total of \$6600 includes funds for a video workstation to replace one of the lab's current systems. We have two computers now, both are entirely adequate today for video editing with Adobe Premiere. A year after Microsoft Vista comes out, system and video software will probably demand more memory and processing power, rendering our current systems unusably slow for video editing. We are also budgeting for a replacement laptop computer. Of the three laptops owned by the lab, two are past their warranty and showing serious signs of wear. We lend the laptops to students—much of the scholarly work under this proposal will be done at libraries (Florida Tech's and other law libraries), and a laptop is much easier to take to a library than a desktop.

Travel

The budgeted amount (\$3600 per year) provides an anticipated \$1200 in expense reimbursement for a domestic conference and \$1800 per international conference. We will reimburse conference expenses for an investigator or a research assistant student who is making a presentation at a conference or who is attending a conference outside of his or her field (such as a lawyer's

conference for a computer science student) in order to learn something directly relevant to a topic s/he is researching for this grant.

Materials and Supplies

The total (\$6000) pays for the usual office supplies. In addition, we will keep two licenses to Adobe Premiere up to date for video production, purchase licenses (upgrades for some of us) to EndNote and other software to support extensive literature reviews, probably including atlas.ti as a tool for organizing the many documents and interviews we will work with. In addition, we will replace up to three aging CRT monitors with LCD displays.

Publication Costs

The budget shows \$8000 per year for publication costs. These are actually subscription costs. We will purchase two subscriptions to Lexis, Westlaw, and Versuslaw (legal research databases). The cost is probably \$150 per month per subscription for Lexis and for Westlaw, and \$400 per year for Versuslaw. We will negotiate for additional short-term student licenses (e.g. for law student intern licenses, which are often available free to an organization that pays for other licenses).

CURRENT & PENDING SUPPORT

CURRENT AND PENDING SUPPORT TO CEM KANER

Current support: NSF grant EIA-0113539 ITR/SY+PE: "Improving the Education of Software Testers." Award **0113539** was made on **08/31/01** for \$ **469,668.00** for 36 months with an effective date of **09/01/01**. I was able to stretch this funding out, via donations from Texas Instruments and consulting payments related to the grant from Rational Software and AutoDesk. However, as of 9/1/06, the final extension will expire and I will have no remaining funds.

There is no other current support for Cem Kaner.

I have a pending application with Texas Instruments for money to support this project (a continuation of the ITR project) until the present proposal is (hopefully) approved. I expect to receive \$25,000 to \$50,000.

I have a pending application to NSF 05-559 CCLI-Phase 2 Expansion, "CCLI-Curricular Support for Software Testing", for \$485,475 over 36 months, starting 09/01/06

CURRENT AND PENDING SUPPORT TO SCOTT TILLEY

- Existing: IBM Faculty Award, \$20K, 2005-2006
- Pending: IBM Faculty Award, \$40K, 2006-2007

CURRENT AND PENDING SUPPORT TO RICHARD FORD

I am currently supported by a grant from the Office of Naval Research (Award Number N00014-01-1-0862), and am in the 2nd year of a 3-year \$309,000 grant from Microsoft Corporation.

FACILITIES, EQUIPMENT & OTHER RESOURCES

FACILITIES: Identify the facilities to be used at each performance site listed and, as appropriate, indicate their capacities, pertinent capabilities, relative proximity, and extent of availability to the project. Use "Other" to describe the facilities at any other performance sites listed and at sites for field studies. USE additional pages as necessary.

Laboratory: We plan to use Kaner's current lab space (rooms 238 and 265 in the Olin Engineering Building) and a large area at Kaner's house that he uses for videotaping and production.

Clinical:

Animal:

Computer: Kaner's lab has two computers capable of video production, plus associated camera equipment. This proposal calls for purchase of an updated computer, probably in two years and an updated laptop and remote storage (some big hard disks for the raw video files and intermediate edits.)

Office:

Other:

MAJOR EQUIPMENT: List the most important items available for this project and, as appropriate identifying the location and pertinent capabilities of each.

Video production computers and Sony camcorder, in Kaner's lab.

OTHER RESOURCES: Provide any information describing the other resources available for the project. Identify support services such as consultant, secretarial, machine shop, and electronics shop, and the extent to which they will be available for the project. Include an explanation of any consortium/contractual arrangements with other organizations.

Florida Institute of Technology web services, for hosting the course materials. The videos require significant transmission bandwidth. Florida Tech already makes space/bandwidth available for the testing course, <http://www.testingeducation.org/BBST>. These materials will require less than that course.
