Using Controlled Failure to Teach Software Development Process to New Developers and Assessing the Results

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The purpose of this presentation is to get help in extended the work discussed to the field of testing

Standish Report 2002
Software Development Times 1/15/2003

- **On-time; on budget; meets require-ments: 34% -- up from 16% in 1994**

- **Compromised (over budget; past schedule; missing functionality): 51%**

- **Failed: 15%**

The Problem I

Lack of training in / acceptance of software process (discipline) on the part of software developers and software project managers … many of whom have undergraduate Computer Science degrees … and weren't taught (an appreciation for) development process.

The Problem II

- Most CS faculty are concerned with advancing the *state of the art*, i.e., Software technology.

- Many are effectively unaware of, and only mildly interested in, the *state of the practice*, i.e., the software development process.

- Many deem courses in software engineering to be of intellectually low caliber, and of little value.

The Problem III

- Software development attracts teamwork-challenged personalities
- Or, perhaps:
  - technology is easy to swallow because its validity can be derived from first principles or directly demonstrated by correctly-executing code
  - but process is non-intuitive, perhaps even counter-intuitive

So

- The need for software development process is learned, if at all, by experiencing project failures over a long period of time
- So…let's accelerate the learning by putting beginning developers through small-scale, controlled failures

Live-Thru Case Histories I

- Select a set of software process issues to be motivated, e.g.:

  - Need for rigorous requirements engineering
  - Need to identify and involve all critical stakeholders
  - need to architect for maintenance and enhancement

Live-Thru Case Histories II

•Select a case history in which the project failed because the chosen issues were ignored or executed badly

  •either give students a tailored-down (4-5 weeks) version of the same project as was given to the original developers
  •or give students the job of just designing the software, coming up with a life-cycle plan, etc. (2-7 days)

Overdue Book Notices

The librarian of a relatively poor rural elementary school of 500 students is still using a manual method for tracking library books on loan. As a book is taken from the library its card is taken from the pocket and filed by date. Books may be borrowed for two weeks. When a book is returned its card is put back into the pocket. A book that is not returned in two weeks is considered overdue and an Overdue Book Notice is sent to the student. Clerks write overdue book notices for about 200 books each week. The notices are distributed weekly.

Overdue Book Notices (cont.)

The following format has been used for the Overdue Book notice for many years:

Glenwood School Overdue Book Notice
Book Title:
Student Name:
Teacher Name:
Date of Notice:
Notice Number   1   2   3   (circle one)
This book is overdue please return it promptly

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Overdue Book Notices (cont.)

A student who does not return a book within three weeks is sent a second notice. A book's not being returned in four weeks results in a third notice to the student and a listing on the head librarian's Critical Overdue Report; the book's card is given to the head librarian for further action.

Overdue Book Notices: Assignment

Automate the overdue book notice process using a computer in the computer class' room. This is the first automation project in this rural school. Data may not be left on the computer from week to week. The computer is not networked. You need not actually implement the system. Rather:

1. Design the screens that the librarian will use
2. Write a 1-2 page user's manual for the system
3. Do a flowchart of the system
4. Design and list a reasonable number of (test case) inputs to the system and show what the output would be if the test cases were input in the listed order

Overdue Book Notices:
Original Development Project

SOFTWARE WAS REJECTED BECAUSE:

•**Overdue notices must be sorted, first by teacher name, then, for each teacher by class:** *otherwise the librarian must sort them by hand*

•**Data entry must be by books not returned, rather than by books returned:** *otherwise entry takes too long*

Overdue Book Notices: Original Development Project (cont.)

Librarians: Our needs are obvious to anybody; we thought software developers are smart people.

Developers: We're smart people; we know what the customer needs.

So: neither bothered talking to the other about detailed requirements

Bad requirements engineering (not lack of technical education/ability) is, by far, the leading cause of failure of software development projects in industry!

Career Services Web Site

Your five-person software team has been approached by the university's Career Development Department to develop a new web site. The business of the department includes:

-training students in: writing resumes, conducting themselves in interviews, finding information about prospective employers before being interviewed, etc.

-providing career guidance, both in group workshops and one-on-one

-running summer internship programs in which students spend close to three months working in industry settings

-presenting an annual Career Fair in which representatives of industry talk to students about opportunities in their companies

-setting up on-campus recruiting sessions at which industry HR and technical representatives interview graduating students for jobs

Career Services Web Site (cont.)

Some of these activities are free, but must be registered for in advance in order to allow the department to plan for adequate space, printed materials, and refreshments. Others require both advance registration and payment of a fee.

Career Services Web Site (cont.)

The problem with the department's current web site starts with the fact that the graphics are unimpressive. It continues with the fact that, among other things, it does not:

-allow department staff to easily update the site online, i.e., without producing html files and uploading and linking them.

-allow students and industry representatives to register online for activities that require advance registration

-automatically keep track of students and/or industry representatives registered for a specific activity, and automatically e-mail them updates and reminders as the date of the activity approaches

-allow potential participants to pay online, with a credit card, for activities and services that bear a charge

Career Services Web Site (cont.)

You have four months from the start of the project's inception until the product's transition to the Career Services Department. The project's requirements are to upgrade the web site with the capabilities listed above.

Career Services Web Site (cont.)

Among the significant technology-related questions that you have identified are:

- whether to use Oracle or mySQL as the database engine

- whether to use PHP, ASP, JSP, or Cold Fusion as the front-end scripting language

- whether to use C++ or Java as the back-end programming language

- whether to use Paypal or some other credit card transaction processing system for taking payments

Career Services Web Site: Assignment

Draw up a project Life Cycle Plan detailing: major risks and methods for dealing with them; deadlines for making critical decision; meetings and/or communications to be held with stakeholders and the purpose of each; design, implementation, and documentation activities to be performed; etc. Be sure to indicate dependences between and among items detailed, and to indicate which development staff members will be involved in each detailed item. You may use Gantt charts, Pert charts, and/or any other reasonable notation.

Career Services Web Site: Assignment

Assume that your development team of five consists of two exceptional programmers and that the other three are average programmers, two of whom have excellent oral and written communication skills. Feel free to make assumptions about particular technical competences of development team members, but be sure to make clear what you're assuming.

Career Services Web Site: Original Development Project

SOFTWARE WAS REJECTED BECAUSE:

•**Career Development Department's web site is maintained by University IT Services**
•**Developers chose to use PHP and mySQL; IT Services doesn't support either. (CSD staff had no knowledge of this.)**
•**Developers chose to use Paypal for credit card payment; university has no contract with Paypal; Career Development Department head would have to sign personal liability form to use it.**

Developers failed to identify and involve all critical stakeholders; failed to identify a non-negotiable requirement of an identified stakeholder

EZ-Bay

EZBay is a (web service application) adjunct to ebay. EZBay is intended to save time for the serious buyer who spends a great deal of time on ebay searching for items of interest.

EZ-Bay (cont.)

A serious buyer will spend large amounts of time on ebay performing the following activities:

• searching for items to buy for his/her collection (items-for-sale searches)

• searching for items already bid on by a specific other ebay user (bidder searches)

• searching for items being sold by a specific ebay seller (seller searches)

EZ-Bay (cont.)

EZBay will enable the user to upload, from any popular browser, as many bookmarked items-for-sale, bidder, and seller search patterns as desired. EZBay will repeatedly run all the searches, at whatever time interval the user has specified. EZBay makes results available to the user on the EZBay web site, and notifies the user, by e-mail, of new matches. The time saving to the user is the avoidance of clicking on each of the potentially hundreds of bookmarked search patterns to locate items of potential interest.

EZ-Bay (cont.)

EZBay will also provide an integrated sniping service. "Sniping" an electronic auction means having a server post a bid for you just a few seconds before the auction's end. Such late bidding doesn't guarantee the sniper's winning the auction, but it does prevent the "auction fever" often generated by competing bidders and increases the likelihood of winning an auction at a lower price than might otherwise be the case. (It also prevents other ebay users from finding out about items of common interest that you have found but they haven't.)

EZ-Bay (cont.)

Payment for EZBay services will be through the use of a point system. Each (item-for-sale, bidder, or seller) search that EZBay runs will be charged a fixed number of points against the user's account; the number of points charged for a snipe, will, be proportional to the dollar amount of the snipe. The user will set up an EZBay account, and will, thereafter, log on to EZBay using an EZBay id and password. Once s/he has an EZBay account, the user will buy points, paying through Paypal. EZBay will notify the user, by e-mail, when his/her point balance is nearing zero.

EZ-Bay (cont.)

You and a group of friends have been developing EZBay and hope to turn it into a business. In fact, you and one other have already quit your jobs to work on EZBay and have obtained a small amount of venture capital. You will be giving a make-or-break presentation to the venture capitalist in three months. If the VC is impressed you will probably have your own business; if not, you'll have to go out and look for a job.

EZBay: Assignment

Do an architectural design of EZBay including at least as much information as is specified in Kruchten's 4+1 Architecture paper. If you have never used ebay, or haven't used it recently, you should spend some time at www.ebay.com exploring ebay's item-for-sale, bidder, and seller searches. If you have never used an internet auction sniping service, you should spend some time exploring www.esnipe.com before starting the design work.

EZBay: Original Development Project

SOFTWARE FAILED OPERATIONAL (VC) TEST BECAUSE:

- Screen "scraping" of data returned by ebay search was distributed all over the code

- Ebay changed its screen formats two days before the VC presentation

- Code could have easily been fixed in a day had screen scraping all been in one place

Product was not architected for (easy) maintenance and enhancement.

Assessing Results

- **ATSE: Attitude Toward Software Engineering**

- **ATASE: Ability to Apply Software Engineering**

- **KOSE: Knowledge of Software Engineering**

ATSE's DEVELOPMENT

- List inappropriate attitudes
- Write questions
- Administer survey to professionals & conduct focus groups (to check understandability and validity of questions)
- Administer survey to students & conduct focus groups (to check understandability of questions and reasons for particular responses)
- Reword badly-phrased/ambiguous questions
- Drop questions on which there is insufficient agreement among professionals (less than 80%)
- Iterate process to refine ATSE (and check reliability)

ATSE ADMINISTRATIONS AND FOCUS GROUPS

- 50 attendees at a North Jersey SPIN meeting (January 16, 2002)
- 7 members of Xerox Corporation's SPI Group at a monthly phone conference (February 11, 2002)
- 50 students finishing the second semester of Stevens Institute's Senior Project course (April 16, 2002)
- 98 attendees of DoD's Software Technology Conference (April 30, 2002); 50 attendees of STC 2003
- 50 attendees of Southern California SPIN meeting (December 6, 2002)
- 120 USC students in Barry Boehm'sCS577 (August & December, 2002)
- 14 CS faculty Portland State University (Jan 6, 2003)
- 23 attendees at colloquium on Live-Thru's Oregon State University (Jan 7, 2003)

CAVEAT

- **A particular respondent may "misinterpret" a question and respond "incorrectly" even though s/he has a good attitude**

- **Responses considered "correct" are those on which at least 80% of professional respondents agree**

- **So: ATSE reliably measures group attitude … changes in group attitude**

RESULTS OF ADMINISTRATION AT USC AUGUST, 2002 I

- *Developers of custom software, that is software being developed for a specific customer, should be shielded from the customer by management (A9)*: **44/124 students either agreed or agreed strongly**

- *If a customer fails to specify everything they need in software being developed for them, then it's the customer's problem if the finished software doesn't work right (A17)*: **39/124 students agreed or agreed strongly**

RESULTS OF ADMINISTRATION AT USC AUGUST, 2002 II

- *It would be unreasonable for a software developer to be told that s/he must have other team members read his/her code (A15)*: **25/124 students either agreed or agreed strongly**

- *Most of the problems given to professional software developers are very clearly defined (A21)*: **21/124 students agreed or agreed strongly**

RESULTS OF ADMINISTRATION AT USC AUGUST, 2002 III

- *When working on a team project, team members should start by coding their own modules and then figure out how to put the modules together (A27)*: **24/124 students agreed or agreed strongly**

- *I would probably get my code debugged and working faster if other people read the code and provided feedback on it (A28)*: **22/124 students disagreed or disagreed strongly**

RESULTS OF ADMINISTRATION AT USC AUGUST, 2002 IV

- *On a COTS-based software development project, that is, a project which will use Commercial Off The Shelf software components, it's best for the project manager to assume that each COTS product will perform as specified in its documentation (A33)*: **43/124 students agreed or agreed strongly**

- *Software development is a sufficiently uncertain/unscientific activity that schedule overruns of less than 50% should be readily accepted by customers (A35)*: **38/124 students agreed or agreed strongly**

RESULTS OF ADMINISTRATION AT USC AUGUST, 2002 V

- *In a software development project it's usually unproductive for the project/manager to consider problems that might conceivably arise before they actually do arise (A36)*: **30/124 students agreed or agreed strongly**

- *It's most efficient for each member of a software development team to be allowed to write code according his/her own preferred coding style/standard (A42)*: **32/124 students agreed or agreed strongly**

RESULTS OF LIVE-THRU LIVE-THRU (OVERDUE BOOK NOTICE) HOMEWORK AT USC AUGUST, 2002 V

Attitude toward:

- **customer interaction**
- **developer's responsibility toward customers**
- **developer's responsibility toward success of software product, and requirements engineering in general**

changed drastically. Not just in responses to ATSE questions, but in short de-briefing reports written by all students

USES OF ATSE, ATASE, AND KOSE

- **Outcomes assessment of software process aspects of complete CS degree programs**
- **Outcomes assessment of individual software engineering courses**
- **Outcomes assessment of industry SPI (software process improvement) efforts**