After the Gold Rush: Prospects for a True Profession of Software Engineering

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Welcome to the Gold Rush
Two Styles of Software Development

- “Gold Rush Development”
- “Post-Gold-Rush Development”
Development Team Characteristics
- Small team sizes
- Tacit work practices
- Minimal or no management
- Indiscriminant risk taking
- Extremely low formal overhead

Sample Product: Microsoft Mac Word 1.0
Post-Gold Rush Software Development

Developer Characteristics
- Larger team sizes are often required
- Formally defined work practices
- Explicit management
- Calculated risk taking
- Higher overhead

Sample Product: Current version of Microsoft Office
“Diffusion of Innovation”
Diffusion Cycle

Innovators

Early Adopters

Early Majority

Late Majority

Laggards

The “Chasm”

Adoption Sequence

“Software Development Best Practices”
Normal Risk/Reward Structure

- High risk / high payoff
- Moderate-high risk / moderate-high payoff
- Moderate-low risk / moderate payoff
- Low risk / moderate payoff
- Low risk / low payoff

Decreasing Risk
Decreasing Reward

"Software Development Best Practices"
How the Software Industry Is Doing at Diffusion of Innovation
Best Practices (year first available)

- Project planning and management practices
  - Automated estimation tools (1973)
  - Evolutionary delivery (1988)
  - Measurement (1977)
  - Productivity environments (1984)
  - Risk-management planning (1981)

- Requirements engineering practices
  - Change board (1978)
  - Throwaway user interface prototyping (1975)
  - JAD sessions (1985)
Best Practices (year first available, cont.)

- Design practices
  - Information hiding (1972)
  - Design for change (1979)

- Construction practices
  - Source code control (1980)
  - Incremental integration (1979)

- Quality assurance practices
  - Branch-coverage testing (1979)
  - Inspections (1976)

- Process improvement
  - SW-CMM (1987)
Causes of Software Failure: KPMG Report

- Project Objectives Not Fully Specified (51%)
- Bad Planning and Estimating (48%)
- Technology New to the Organization (45%)
- Inadequate/No Project Management Methodology (42%)
- Insufficient Senior Staff on the Team (42%)
- Poor Performance by Suppliers of Hardware/Software (42%)
State of the Practice: Project Resolution

Project Outcomes 1994-2004

- Failed
- Late / Over Budget
- On Time / On Budget


“Software Development Best Practices”
Many key practice have been proven effective for 15 years or more
We have known how to avoid most software development problems for 15 years or more
What is needed to encourage projects to use these key practices?
Diffusion has not been working very well
Software’s Unusual Risk/Reward Structure

- High risk / high payoff
- Moderate risk / high payoff
- Low risk / high payoff
- Moderate risk / low payoff
- High risk / low payoff

Decreasing Risk → Decreasing Reward

Increasing Risk
Some Software Examples

New practices (not mentioned in this talk)

Most practices from earlier slide

SW-CMM

Waterfall lifecycle model

Code-and-fix development

Decreasing Risk

Decreasing Reward

Increasing Risk
Why Isn’t Diffusion Occurring?
Programmer Education

- Bachelor’s degree: 47.3%
- Associate's degree: 11.0%
- Some college, no degree: 17.2%
- High school graduate or less: 11.8%
- Graduate degree: 12.8%

"Software Development Best Practices"
Details on Education

- About 40% of all workers have a software-related degree
- About half of the 40% obtained a degree in something else first
- About 20% have a degree in something else, but no software-related degree
- About 40% do not have a 4-year degree
If you’re truly in a gold rush, you would be foolish to add formal processes, training, QA, or other development practices that impair your ability to pick up the gold!
"Wanted: Young, skinny, wirey fellows not over 18. Must be expert riders willing to risk death daily. Orphans preferred. Wages $25 per week"  
- Pony Express advertisement, 1860

We realize the skills, intellect and personality we seek are rare, and our compensation plan reflects that. In return, we expect TOTAL AND ABSOLUTE COMMITMENT to project success-overcoming all obstacles to create applications on time and within budget"  
- Seattle Times, Software developer advertisement, present day
Average Practice is Close to the Worst Practice

"Software Development Best Practices"
In 2000, 81 percent of all small-company CEOs (<500 employees) surveyed thought an IPO was “very likely” or “somewhat likely”.

Of Inc. Magazine’s 500 fastest growing companies in 1998, 108 planned an IPO within 12 months.

continued...
One year later, in 2001, only 8 of 108 had actually gone public or filed to go public

In other words, 80% of companies think they are in a gold rush, but less than 10% really are
“By mid 1849, most of the easy gold had been found, which meant that a typical miner spent 10 hours a day in ice cold water, digging, sifting, and washing. As time passed, this backbreaking work yielded less and less gold. There were occasional lucky strikes well into the 1850s, which provided just enough good news to encourage thousands to keep digging. Most failed every day, but they kept on for years.”
“The root of all superstition is that men observe when a thing hits but not when it misses.”

-- Francis Bacon
Why People Believe in Gold Rush Development (expressed in today’s terms)

This is the only project people notice

Gold rush companies ordered by time

“Software Development Best Practices”
The Problem

- The problem with gold-rush development practices is that every once in a while they work!
Do We Still Need to Worry About This Phenomenon in 2006, Part I?

[Headline] “A Healthy Bubble: The Second Biggest Year in Software M&A in the Last 20 Years”

“2006 is shaping up to be the biggest year in software M&A since the turn of the century... Volumes are up and equally importantly, blue chips are increasingly buying early stage companies.”

-- Nat Burgess, Corum Group
Do We Still Need to Worry About This Phenomenon in 2006, Part II?

[There] “seems to be a new bubble in the software industry. Signs of this bubble include a hiring crunch, soaring salaries, and M&A feeding frenzy, and an accelerated push by NASDAQ to launch a new generation of tech companies into the public market. One industry veteran we spoke to told us that ‘people outside the Valley don’t understand how crazy things have gotten. It is like 1999 all over again.’”

-- SoftLetter, April 15, 2006
Do We Still Need to Worry About This Phenomenon in 2006, Part III?

- 1967: Fortune Magazine reports that 100,000 programmers are working in the U.S., and there are 50,000 job openings (i.e., a labor shortage of 33%)
- 1999: Various sources cite a 20-30% labor shortage in the U.S.
- 2006: CNN and Money magazine report that “Software Engineer” is the 2nd fastest growing job out of 216 jobs
- The “Gold Rush Feeling” is normal for software development; the past few years were the aberration
Food for Thought
(Courtesy of the U.S. Department of Agriculture)

- U.S. Agricultural Extension Service has been the most successful technology diffusion program in the world.
- Agricultural extension employs 17,000 people to serve 3.8 million farm workers.
- SEI employs 300 people to serve 1.8 million software workers.
- Diffusion has not and will not occur by itself!
General Approaches to Diffusion

 conseils Organizational level
◆ Hospitals, universities, accounting firms
◆ Mechanism is organizational assessment
◆ This is already happening through SW-CMM and CMMI

 conseils Individual level: Professionalism
◆ Doctors, nurses, professors, accountants
◆ Mechanisms are certification and licensing
◆ This is underway in software engineering
After the Gold Rush: Creating a True Profession of Software Engineering
My Contention

- Most companies are not in gold rush situations (even if they think they are)
- Post-gold-rush development practices work better in non-gold-rush circumstances
- Post-gold-rush development practices work better even during a gold rush
  - But only if you’re ready ahead of time
Elements of a Profession

- Individual Professional Development
- Infrastructure Support for the Profession
- Professional Society Influences

- Initial Professional Education
- Accreditation

- Skills Development

- One or both:
  - Certification
  - Licensing

- Professional Societies
  - Code of Ethics
  - Professional Development

- Full Professional Status

"Software Development Best Practices"
Many of the elements already exist
The rest are underway
Further details on the following slides...
Professional Societies Already Exist

- IEEE Computer Society
  www.computer.org

- Association for Computing Machinery
  (ACM) www.acm.org
A “Code of Ethics and Professional Conduct” was adopted by the ACM and IEEE-CS in 1998

- see www.computer.org/certification/ethics.htm

Similarly, “Guideline on Professional Responsibilities in Developing Software,” by APEGGA

- see www.aipegga.org/pdf/Guidelines/software.pdf
Software Engineering Body of Knowledge (SWEBOK) Project

- Goal is to define software engineering’s body of knowledge
- Project has released version 2 (“2004” version)
- The following knowledge areas are being used:
  - Construction
  - Configuration Management
  - Design
  - Tools and Methods
  - Maintenance
  - Management
  - Process
  - Quality
  - Requirements
  - Testing

- For more information, see www.swebok.org
Masters Degree Programs Are Well Established

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<tr>
<th>U.S.</th>
<th>U.S. (cont.)</th>
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<tbody>
<tr>
<td>Andrews University</td>
<td>San Jose State University</td>
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<td>Auburn University</td>
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<td>East Tennessee State University</td>
<td>University of Alabama-Huntsville</td>
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<td>Embry-Riddle Aeronautical University (Florida)</td>
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<td>Florida A&amp;M University</td>
<td>University of Houston-Clear Lake</td>
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<td>Florida Atlantic University</td>
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<td>George Mason University</td>
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<td>International Technological University</td>
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<td>Kansas State University</td>
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<td>Monmouth University</td>
<td>University of West Florida</td>
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<tr>
<td>National Technological University</td>
<td>University of Wisconsin-LaCrosse</td>
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<tr>
<td>Naval Postgraduate School</td>
<td>West Virginia University</td>
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<tr>
<td>North Dakota State University</td>
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Ph.D. Programs Are Still New

- Carnegie Mellon University
- Naval Postgraduate School
- North Dakota State University
- University of Texas at Dallas
New Undergraduate Programs Are Being Created. All But One of these has been Created Since 1999…

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<tr>
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<tr>
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<td>Butler University</td>
<td>Montana Tech</td>
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<td>California Poly – San Luis Obispo</td>
<td>National University</td>
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<td>Capitol College</td>
<td>Penn State University – Erie</td>
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<td>Champlain College</td>
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<td>Clarkson University</td>
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<td>Indiana Wesleyan University</td>
<td>University of Wisconsin-Platteville</td>
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<td>Michigan Tech</td>
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<td>Milwaukee School of Engineering</td>
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<td>Mississippi State University</td>
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<td>Missouri Tech</td>
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*Created in 1996
** List current as of Fall 2005
New Undergraduate Programs Are Being Created. Programs in Canada…

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<th>Canada</th>
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<td>Carleton University</td>
<td>University of Ottawa</td>
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<td>Concordia University</td>
<td>Univeristy of Regina</td>
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<td>McMaster University</td>
<td>University of Saskatchewan</td>
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<td>Memorial University</td>
<td>University of Toronto</td>
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<td>Queen’s University</td>
<td>University of Victoria</td>
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<td>Simon Fraser University</td>
<td>University of Waterloo</td>
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<td>University of Western Ontario</td>
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<td>York University</td>
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<td>University of Montreal</td>
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<td>University of New Brunswick</td>
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<tr>
<td>University of Northern British Columbia</td>
<td>** List current as of 2004 **</td>
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Accreditation of Undergraduate Programs—U.S.

- Accreditation of undergraduate university programs is being done by ABET:
  - Auburn University
  - Clarkson University
  - Embry-Riddle Aeronautical University
  - Florida Institute of Technology
  - University of Michigan-Dearborn
  - Milwaukee School of Engineering
  - Mississippi State University
  - Monmouth University
  - Rochester Institute of Technology
  - University of Texas at Arlington

- Complete list available from ABET’s website at www.abet.org/accrediteac.asp
Accreditation of undergraduate university programs in Canada is done by CEAB:

- University of Calgary (2002) - Calgary, Alberta
- Carleton University (2003) - Ottawa, Ontario
- Concordia University (2002) - Montreal, Quebec
- Lakehead University (2002) - Thunder Bay, Ontario
- McMaster University (2001) - Hamilton, Ontario
- University of Ottawa (2001) - Ottawa, Ontario
- University of Western Ontario (2001) - London, Ontario
- Ecole de Technologie Superieure (2004) - Montreal, Quebec
Certification of Software Engineers (Voluntary)

- IEEE CSDP Certification was rolled out in early 2002
- About 550 CSDP Certificate holders as of Spring 2006
Licensing of Software Engineers (Mandatory)

This is already underway

- Canada
  - British Columbia
  - Ontario

- U.S.
  - Texas (though a bit uncertain right now)
Conclusion & Resources
## Elements of a Software Engineering Profession

<table>
<thead>
<tr>
<th>Element</th>
<th>Current Status</th>
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<tbody>
<tr>
<td>Initial Professional Education</td>
<td>Established and moving toward Maturing</td>
</tr>
<tr>
<td>Accreditation</td>
<td>Established</td>
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<td>Skills Development</td>
<td>Established</td>
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<td>Certification</td>
<td>Established</td>
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<tr>
<td>Licensing</td>
<td>Ad Hoc</td>
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<tr>
<td>Professional Development</td>
<td>Ad Hoc, moving toward Established. For examples, see the IEEE Computer Society’s continuing education guidelines at <a href="http://www.computer.org/certification/">www.computer.org/certification/</a>.</td>
</tr>
<tr>
<td>Professional Societies</td>
<td>Established, moving toward Maturing. The IEEE Computer Society, ACM, and CIPS</td>
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<td>Code of Ethics</td>
<td>Established.</td>
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<tr>
<td>Organizational Certification</td>
<td>Established, moving toward Maturing.</td>
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"Software Development Best Practices"
Is This the Ultimate Answer?

“Truth will sooner come out of error than from confusion.”
– Francis Bacon
Professionalism Resources

- Professionalism Website: www.construx.com/professionaldev
- Wikipedia article on software engineering en.wikipedia.org/wiki/Software_engineering
- IEEE Software Magazine www.computer.org/software/
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