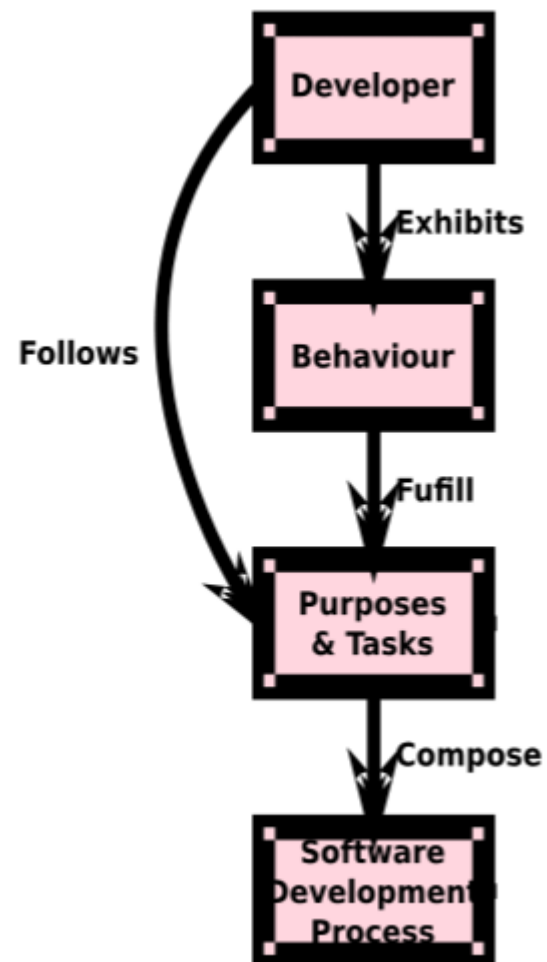


Software Process

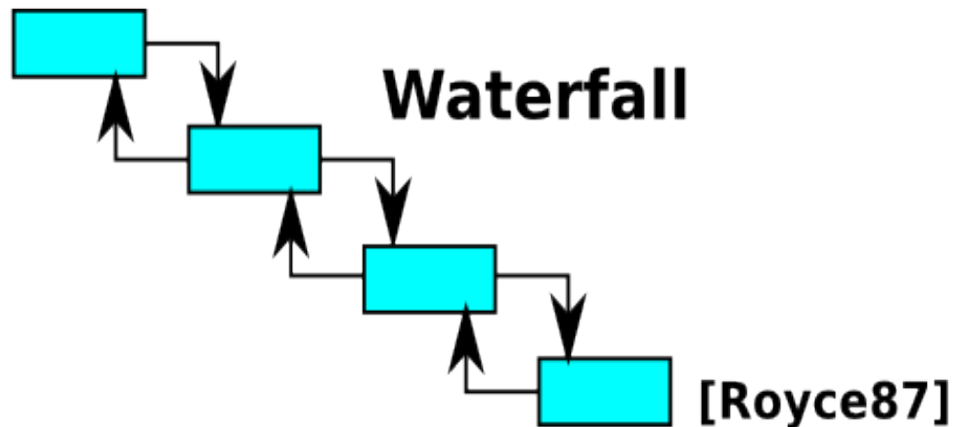
Dr. Hazel Campbell
Dr. Abram Hindle
Dr. Ken Wong
Department of Computing Science
University of Alberta

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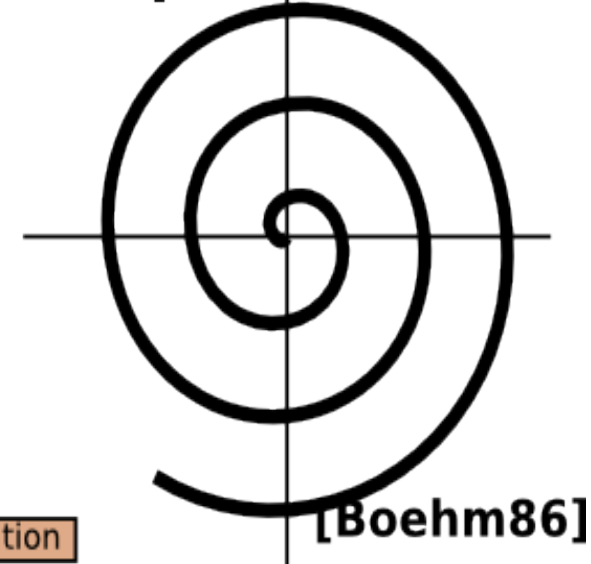
What makes a Process?



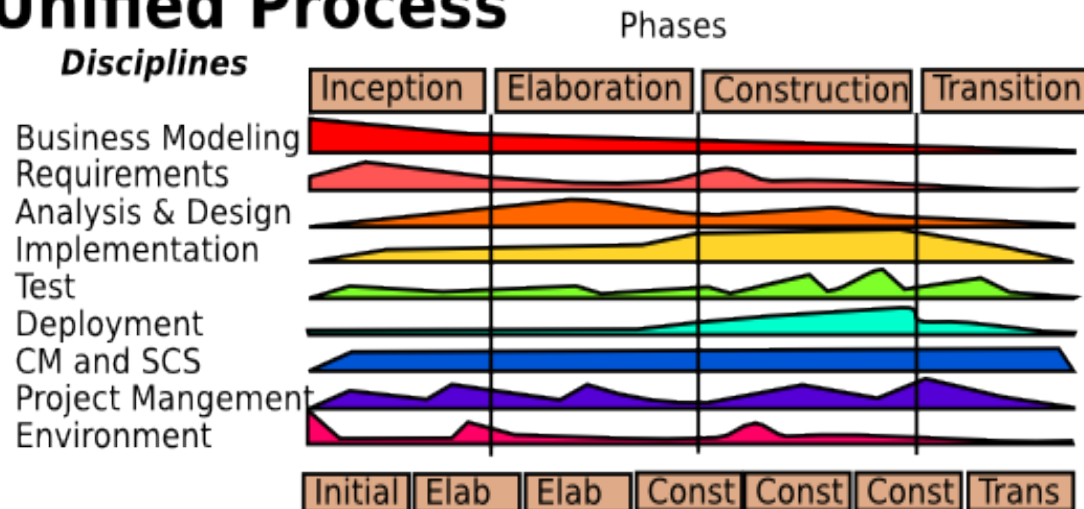
Software Development Processes



Spiral



Unified Process



[Jacobson99]

Developer Perspective

- Software Engineering:
 - manage complexity, scale, lifetime
 - increase quality
 - reduce defects
 - reduce maintenance and support costs
 - reduce time-to-market
 - reuse successful solutions
 - apply methods and tools
 - iterate and optimize

User Perspective

- Software Usability:
 - meets needs
 - increase productivity
 - easy to learn
 - effective to use
 - reduce errors
 - safe to use

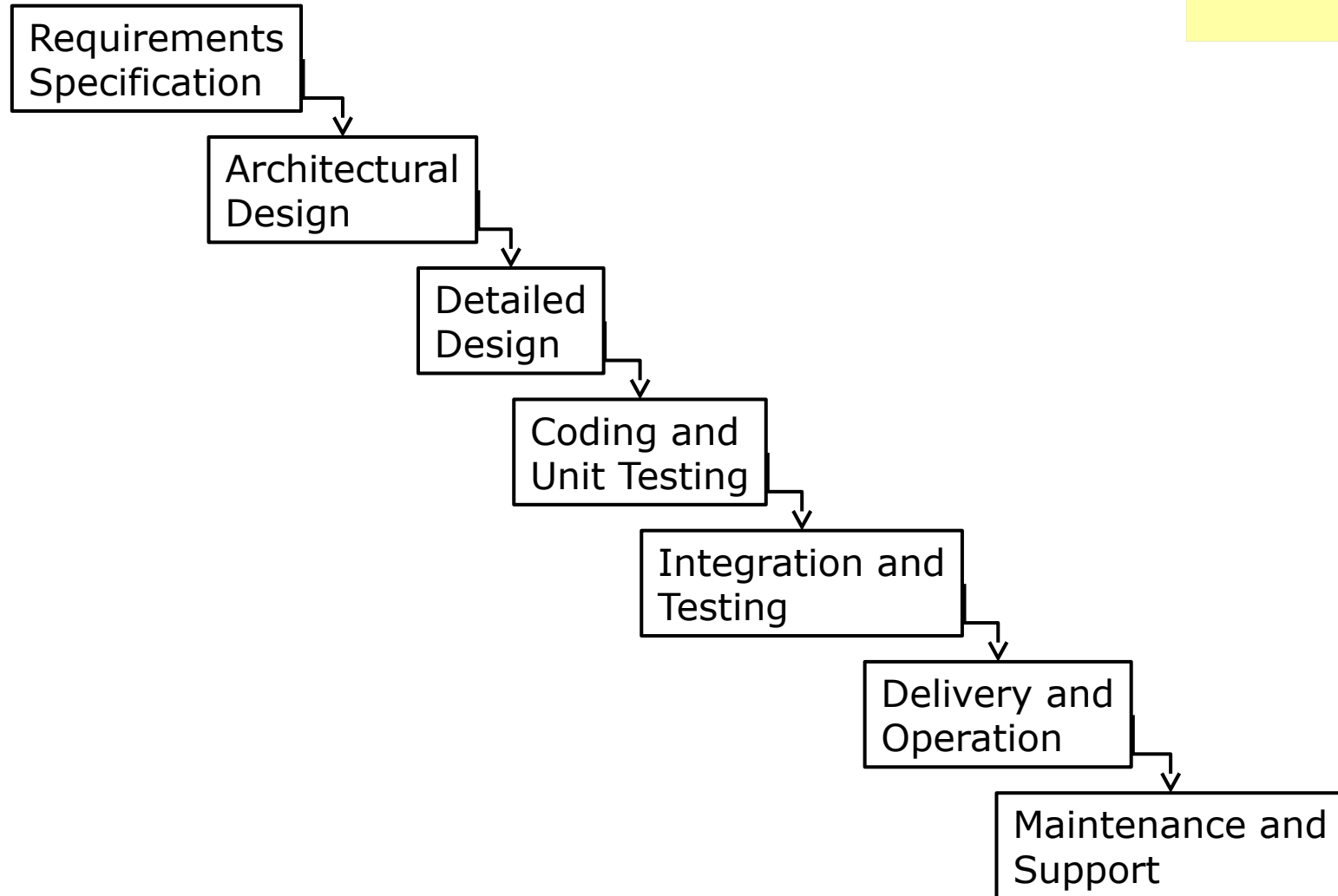
User Perspective

- User Experience (UX):
 - Satisfying
 - Motivating
 - Looks nice (aesthetically pleasing)
 - Enjoyable
 - Fun

Meeting Needs

- Verification
 - making sure you develop the system right
 - according to the requirements

Waterfall Lifecycle Model



Waterfall

- Pros:
 - Easily understood
 - Enforces Discipline
 - Verification at every phase
 - Well documented product

Waterfall

- Cons
 - uses a manufacturing view of software
 - most software is not made as a “final” product
 - customer must be patient
 - but time-to-market is critical
 - customer sees the system only at the end
 - may not satisfy their real needs
 - No early feedback!

Waterfall

- Cons
 - Requirements need to be right (accurate) at the start
 - This is almost never the case
 - Could end up building the wrong system
 - Hard to predict all necessary requirements
 - Hard to react to changing requirements
- Waterfall doesn't work
 - We need to be able to iterate!

Prototyping

- It's hard to get the requirements right at the start...
- But we need validation...
 - making sure we develop the right system
 - Making sure we build what the customer really needs
- One solution: Prototyping!

Prototyping

- Iterative design
 - Cycling through several designs
 - Improve the product with each pass

Prototyping

- Types of prototyping:
 - Throwaway Prototyping
 - Incremental Prototyping
 - Evolutionary Prototyping
- These can be combined!

Throwaway Prototyping

- Process
 - Build and test prototype
 - Learn about:
 - What's needed for the real product
 - What works
 - What does not work
 - Throw away the prototype
 - Then develop the real product

Throwaway Prototyping

- Pros
 - more communication between users and developers
 - functionality is introduced earlier, which is good for morale

Throwaway Prototyping

- Cons
 - The throwaway prototype must be built very quickly
 - some qualities may be sacrificed, like security, reliability, etc.
 - temptation to use the throwaway prototype in the final product

Incremental Prototyping

- Process
 - Triage system into separate “increments”
 - Example: “must do”, “should do”, “could do”
 - Develop and add one increment at a time
- Example: Accounting System
 - Prototype 1: general ledger
 - Prototype 2: accounts receivable/payable
 - Prototype 3: payroll

Evolutionary Prototyping

- Process
 - Each feature is refined or “evolved” over time
- Example: Text Editor
 - Prototype #1: Keyboard Cut and Paste
 - Prototype #2: Touchscreen Cut and Paste
 - Prototype #3: Cut and Paste works with Undo

Other Kinds of Prototypes

- User Interface Sketches
 - Hand Drawn
 - or using a drawing Tool
 - Figma, Balsamiq, etc.
- Storyboards
 - Graphical depiction of the user interface
 - Like a comic strip, but only draw the UI

Other Kinds of Prototypes

- Physical Mockups



Balsa wood mock-up



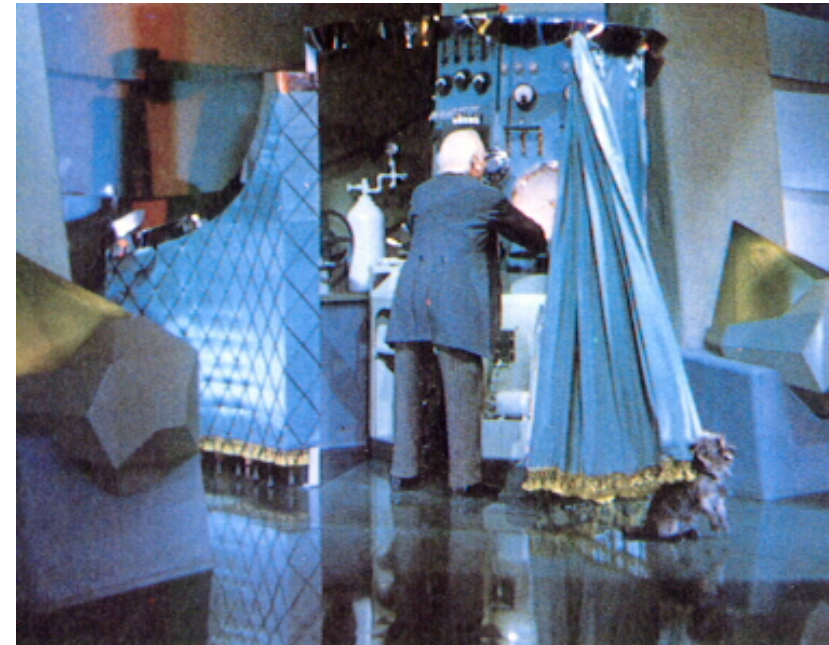
Partial clay mock-up



Precision mock-up

Other Kinds of Prototypes

- Wizard of Oz
 - “Pay no attention to that man behind the curtain!”
 - feature is actually “implemented” through human intervention “behind the scenes”



Agile Practices

- Created with the release of the
- “Agile Manifesto”
 - <http://agilemanifesto.org/>

4 Agile Values

- “Individuals and Interactions”
- “Working Software”
- “Customer Collaboration”
- “Responding to Change”

4 Agile Values

- “Individuals and Interactions”
 - trust motivated individuals
 - face-to-face conversation
 - best work emerges from self-organizing teams
 - team reflects on and adjusts their behavior
 - promote constant, sustainable pace

4 Agile Values

- “Working software”:
 - the main measure of progress
 - continuous, frequent delivery of value

4 Agile Values

- “Customer collaboration”:
 - customers and developers work together
 - satisfy customer early

4 Agile Values

- “Responding to change”:
 - welcome changing requirements, even late
 - technical excellence and good design
 - simplicity—art of maximizing work not done

Interlude: Prioritizing Stories (Features)

- High priority
 - **Must** be done
 - Do it first
 - Risk level:
 - Will cause big problems if we don't do it (first)
 - Will cause big problems if it breaks

Interlude: Prioritizing Stories (Features)

- Medium priority
 - **Should** be done
 - Do it second
 - Risk level:
 - Will cause some problems if we don't do it
 - (before other user stories)
 - Will cause some problems if it breaks

Interlude: Prioritizing Stories (Features)

- Low priority
 - **Could** be done
 - Do it third
 - Risk level:
 - Only minor problems if we don't do it
 - (before other user stories)
 - Only minor problems if it breaks

Interlude: Prioritizing Stories (Features)

- No priority
 - We'd like it but we **won't** get it
 - Do it last
- Risk level:
 - No problems if we don't do it
 - (before other user stories)

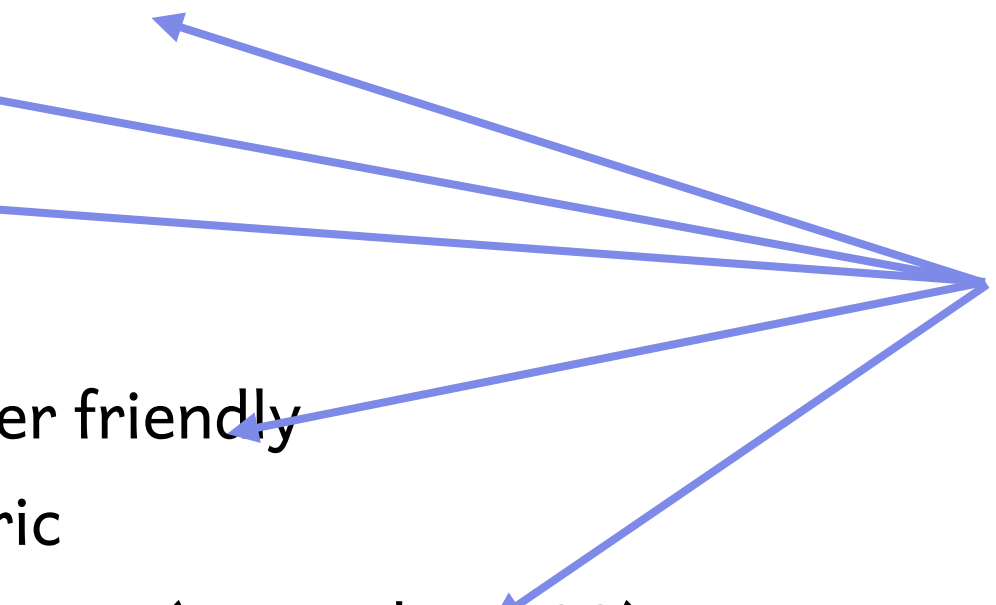
Interlude: Estimating Cost

- Agile “flying fingers” method – wisdom of the crowd!
 - 1) Read a user story, discuss it if necessary
 - 2) Then, everyone puts their hand behind their back, out of sight, holding up the number of fingers for the user story
 - 3) Someone counts: one... two... three...
 - 4) All the fingers come flying out at once!
 - 5) If the deviation is small – choose a mean and write it down. Move to the next story.
 - 6) If there is substantial disagreement – discuss and repeat!

eXtreme Programming (XP)

- <http://www.extremeprogramming.org/>
- Predecessor to Agile

XP

- Philosophy:
 - communication
 - feedback
 - simplicity
 - programmer friendly
 - code-centric
 - for small teams (up to about 20)
 - requires courage
- Same as Agile!
- 
- ```
graph LR; A[Same as Agile!] --> B[communication]; A --> C[feedback]; A --> D[simplicity]; A --> E[programmer friendly]; A --> F[code-centric]; A --> G[for small teams (up to about 20)];
```

# XP

- 12 practices:

- 40 hour week
- metaphor
- simple design
- collective ownership
- coding standards
- small releases
- continuous integration
- refactoring
- planning game
- testing
- on-site customer
- pair programming

Same as Agile!

```
graph TD; Center((Same as Agile!)) --> P1[40 hour week]; Center --> P2[metaphor]; Center --> P3[simple design]; Center --> P4[collective ownership]; Center --> P5[coding standards]; Center --> P6[small releases]; Center --> P7[continuous integration]; Center --> P8[refactoring]; Center --> P9[planning game]; Center --> P10[testing]; Center --> P11[on-site customer]; Center --> P12[pair programming];
```

# XP

- For programmer welfare:
  - “40 hour week”
  - work no more than 40 h a week
  - never work overtime a second week in a row

# XP

- For shared understanding:
  - “metaphor”
    - guide development with a shared story of how the system works
  - “simple design”
    - design the system as simply as possible; remove extra complexity when discovered

# XP

- For continuity:
  - “small releases”
    - put simple system into production quickly, then release new versions on a very short cycle
  - “continuous integration”
    - integrate and build the system many times a day
  - “refactoring”
    - restructure the system to improve its design, simplicity, or flexibility

# XP

- For feedback:
  - “planning game”
    - determine scope of the next iteration and overall release together with customer
  - “testing”
    - write automated unit tests first before the code; customer writes tests in requirements
  - “on-site customer”
    - include real, live user on the team, available full-time to answer questions quickly



# XP

- For synergy:
  - “pair programming”
    - have all production code written with two programmers actively at one machine
    - Prevents Individual Code Ownership!

## XP: So why is it called “extreme?”

- if short iterations are good,
  - make them really short
- if simplicity is good,
  - make the simplest thing that works
- if design is good,
  - do it all the time (refactoring)
- if testing is good,
  - write tests first, and do it all the time (test-driven development)
- if code reviews are good,
  - do it all the time (pair programming)

# Pair Programming

- Synergies:
  - more ideas
    - complementary skills
    - better consideration of alternative solutions
  - learning
    - expert/student apprenticeship
    - continuous critique to learn new things

# Pair Programming

- Synergies:
  - pressure
    - they do not want to let each other down, or waste each other's time
  - courage
    - they give each other confidence to do things they might avoid if alone

# Pair Programming

- Synergies:
  - reviews
    - better able to reveal defects with more eyes looking at the code
  - debugging
    - bugs reveal themselves when one explains the misbehaving code to the other

# Scrum

- One **part** of an agile development process
  - based on
    - Feedback
    - Roles
    - Meetings
    - Prioritization
    - planning
  - like classic engineering management, and is often used onsite in civil engineering

# Scrum

- Roles:
  - Scrum master
    - knows the process (agile, xp...)
    - protects the team and helps the team follow Scrum
  - product owner
    - represents the customer
  - team members
    - write the code

# Scrum

- Meetings:
  - daily scrum (1 per **day**)
  - planning meeting (1 per iteration)
  - review meeting (1 per iteration)
  - retrospective meeting (1 per iteration)



# Scrum

- Daily scrum also known as standup
  - time limited
  - everyone is standing, so they are more uncomfortable and want to finish soon
  - each team member answers 3 questions
    - what did you do?
    - what are you going to do?
    - what is blocking you?

# Scrum

- Planning meeting:
  - first meeting of the iteration (only on first day)
  - input: requirements and user stories
  - output: choose stories to work on next
    - estimate their cost in time
    - prioritize them
    - fit them into the time left for the iteration

# Scrum

- Review Meeting
  - review work completed
  - review work not completed
  - demonstrate current system

# Scrum

- Retrospective Meeting
  - review issues faced with quality and personnel
  - try to improve the process
  - what went well?
  - what could be improved?
  - stay calm



# More Information

## Articles:

“A Rational Design Process:  
How and Why to Fake It”

- D. L. Parnas and P. C. Clements
- IEEE TSE, 12(2), 1986

“Software Development Worldwide:  
The State of the Practice”

- M. Cusumano, A. MacCormack,  
C. F. Kemerer, and W. Crandall
- IEEE Software, November/December 2003



# More Information

## Articles:

### “How Microsoft Builds Software”

- M.A. Cusumano and R.W. Selby
- Comm.ACM, 4(6), 1997



# More Information

## Books:

### Software Project Survival Guide

- S. McConnell
- Microsoft Press, 1998

### The Build Master

- V. Maraia
- Addison-Wesley, 2005



# More Information

## Books:

### Extreme Programming Explained

- K. Beck
- Addison-Wesley, 2004

### Pair Programming Illuminated

- L. Williams and R. Kessler
- Addison-Wesley, 2002