Inf2C: Software Engineering

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About this course

This course has two main jobs:

- give you an overview of what software engineering is
- take you beyond programming to engineering software

This is a tall order for one 10pt course!

Why do this course?

Because software engineering is fascinating :-)

– blend of human and technical challenges; fast-moving; important

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Job relevance!

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- Explain how to apply commonly agreed ethical principles to a software engineering situation.
- Motivate and describe the activities in the software engineering process.
- Construct use cases for an application scenario.
- Explain and construct UML class diagrams and sequence diagrams.
- Explain how a software system and its construction may be assessed using testing and other relevant techniques.
- Evaluate aspects of human usability of an application program or web site.
- Compare different approaches to software licensing.
- Use a modern IDE (Integrated Development Environment) to build a large Java system, making appropriate use of configuration management, testing and other appropriate tools.

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Lectures as guidance and overview (not self-contained notes).

Self-study (web, Java)

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Support: Bulletin board. Tutorials. Email only if your query is personal or confidential.

Books

No book is essential.

The following are worth considering:

Somerville, *Software Engineering*
- Large, classic. Comprehensive on SE, but limited on UML and Java.

Stevens with Pooley, *Using UML*
- Covers basic SE, does UML thoroughly, no Java.

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Hard projects

everything else. Projects with *all* the above challenges, and more.

Statistics

The Standish Chaos reports on medium-larg organisations classify software development projects:

- Succeeded
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- Failed (i.e., cancelled without delivering anything)

Methodology not perfect, but statistics are indicative.

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  1994: 16% ... 2004: 29% ...2009: 32%)
- Challenged (i.e., delivered something but maybe reduced scope, late, over budget)
  no real trend, around 50%
- Failed (i.e., cancelled without delivering anything)
  1994: 31% ... 2004: 18% ...2009: 24%)

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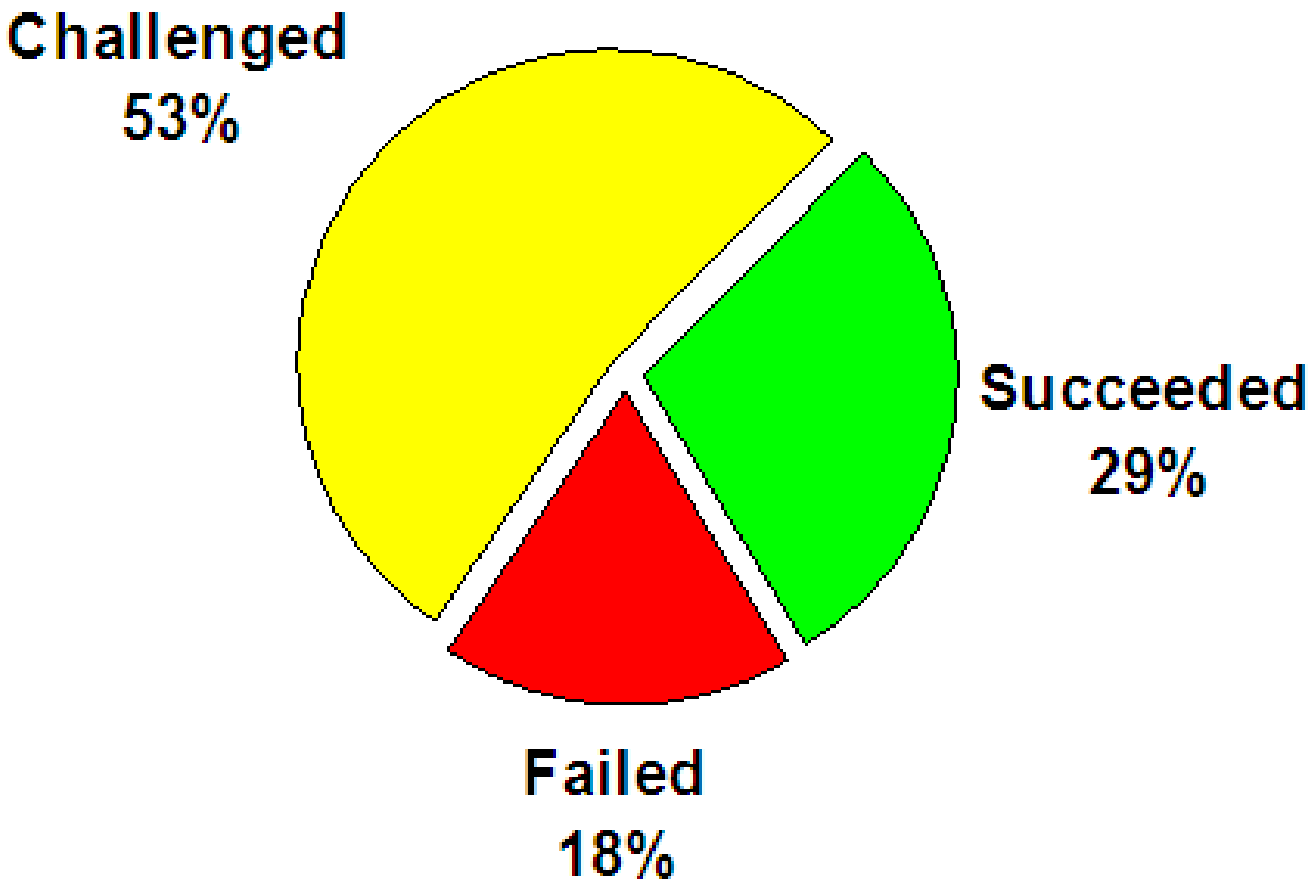
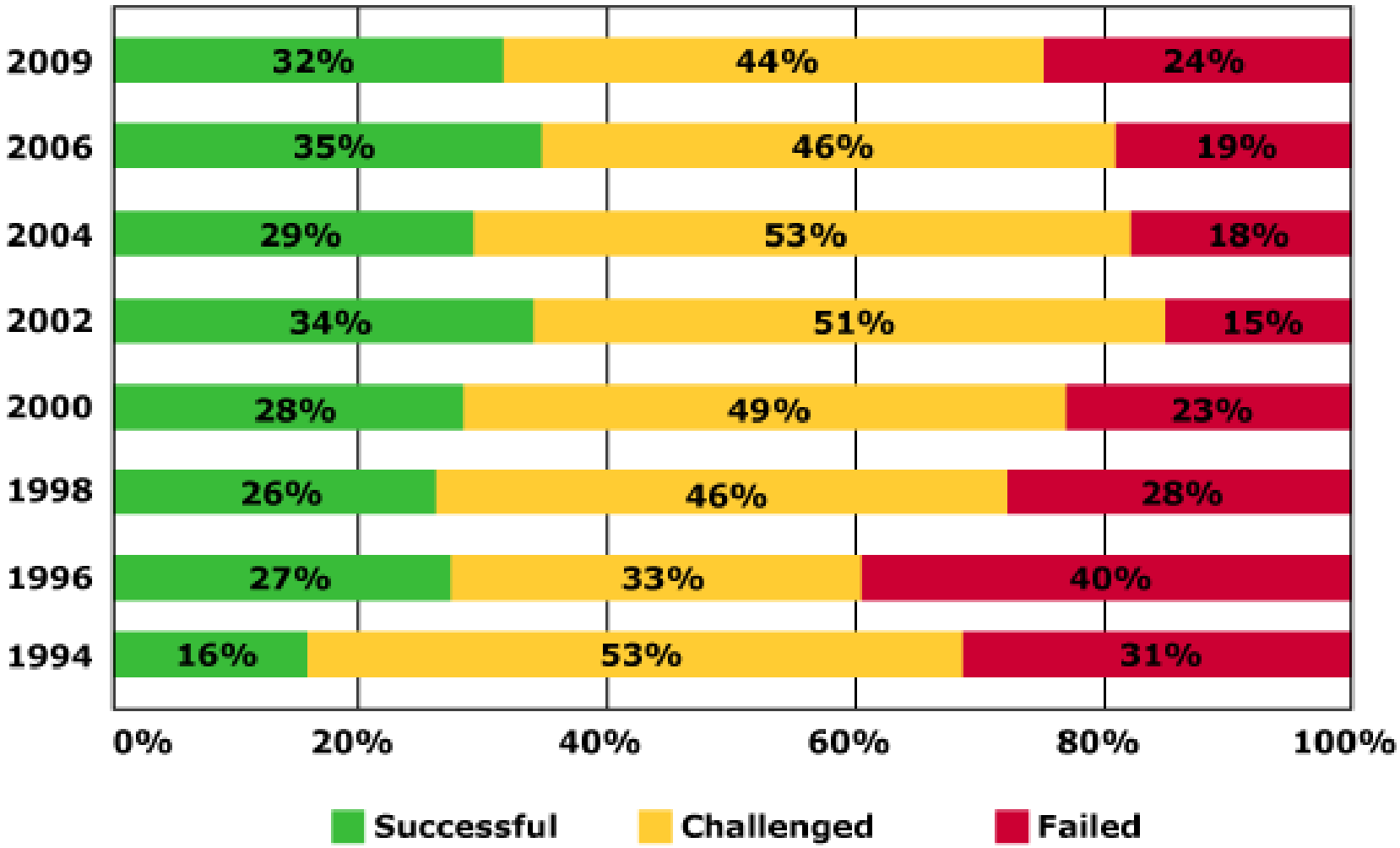
CHAOS 2004

Survey Results

Resolution of Projects



Standish Chaos trends to 2009



The fundamental tension

control $\leftrightarrow$ flexibility

Historically a natural tendency to tackle problems with ever greater control, e.g.

- uncertain requirements
- overruns of time or budget

Greater control: more planning, more documentation, tighter management...

More *ceremony*.

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In this course we try to give you a flavour of both approaches.

Software engineering activities

Syllabus list:

- *requirements capture*
- *design*
- *construction*
- *testing, debugging and maintenance*
- *software process management*

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software development process: How these activities are ordered and related

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Identifying what the software *must do* (not *how*). Recorded using a mixture of *structured text* and *use case diagrams*.

Interesting issues:

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- Multiple stakeholders often with different requirements – how to resolve conflicts?
- Prioritisation. Which requirements should be met in which release?
- Maintenance: managing evolving requirements.

Techniques: use e.g., case analysis, viewpoint analysis, rapid prototyping.

Design

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Techniques: e.g., introspection, reviews of various kinds, design patterns, Class-Responsibility-Collaboration (CRC) cards...

Construction/implementation

More general than "coding", includes:

- detailed design (the level that doesn't get written down)
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- unit testing
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- developer-targeted documentation

Interesting issues: scale: managing large amounts of detail, esp. code. Need systems that work when it's not possible for one person to know everything.

Techniques: Lots of software tools...

Testing and debugging

Testing happens at multiple levels, from unit tests written before coding by developer, to customer acceptance testing.

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Techniques: software tools e.g. JUnit, Selenium, IDE debugger.

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Interesting issues: retaining flexibility; when to refactor/rearchitect/retire/replace system

Techniques: e.g., refactoring

Software process management

Meta-level activity. How can a group of people carry out all these activities so as to produce software that customers are happy to pay for?

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Interesting issues: balancing flexibility against controllability, producing just enough paper; enabling continual improvement of process.

Techniques: e.g., reviews, various kinds of certification, Capability Maturity Model.

Software engineering discipline

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Should software engineers be chartered? Should they be legally required to be?

Ethics

As software has come to be more depended on, the dangers of unethical – immoral – behaviour of software engineers have become more apparent. This is a major argument for chartering software engineers.

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It all seems simple — until you spot the conflicts. E.g.:

Your company depends on a major contract from Client X. Client X insists you use Software Y to develop a product (3.08) on which people's lives depend. You are not satisfied with Y's correctness, and think using it might introduce a risk of life-threatening failure of the product (1.03). What do you do?

Reading

Aim: deepen your understanding of what software engineering is and why the term was invented and is still used, and why problems still exist.

Compulsory: Read the ACM/IEEE Ethics code `http://www.acm.org/about/se-code` and think about cases where the principles might conflict.

Compulsory: Read the coursework (on web page)

Suggested: browse the proceedings of the NATO conferences on Software Engineering (see web page).

Suggested: Somerville Chapter 1 and/or Stevens Chapter 1.

Suggested: google Chaos Standish reports, find e.g. `http://www.infoq.com/articles/Interview-Johnson-Standish-CHAOS`

Suggested: google software engineering ethics.