Software Engineering

WS 2010/11

Everything on these slides can also be found on the Web site: http://www.st.cs.uni-saarland.de/edu/se/2010/

A Software Crisis

Denver International Airport (DIA)

Construction started in 1989 • 53 sq miles • Planned: 1.7 bio USD costs, opening 1993

Denver International Airport

- Approved for construction in 1989
- First major airport to be built in the United States in over 20 years.
- Three terminals + several runways
- Built on 53 square miles of land (Twice the size of Manhattan Island!)

BAE Contract

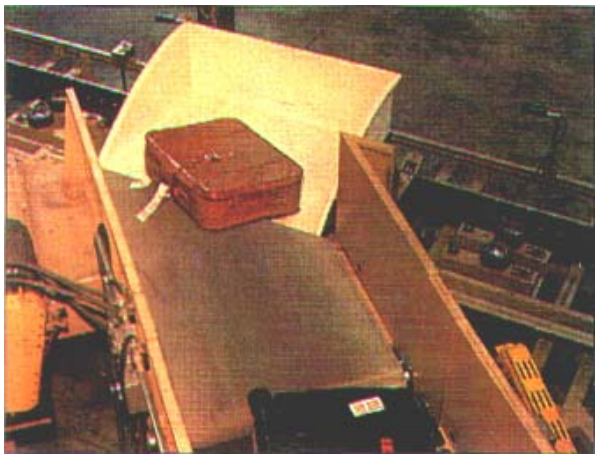
- Original assumption: Every company builds its own baggage transport system
- United (70% Denver traffic) was the only to begin planning; contract with BAE
- First fully automated baggage system
- Later, Denver airport extended contract to entire airport – three times original size

The Scope

- 20 miles of track
- 6 miles of conveyor belts
- 56 laser arrays that read bar coded tags
- 400 frequency readers
- 3,100 standard size baggage 'Telecars'
- 450 6.5 ft by 4 ft oversize cars
- 55 separate computers

The System

The System



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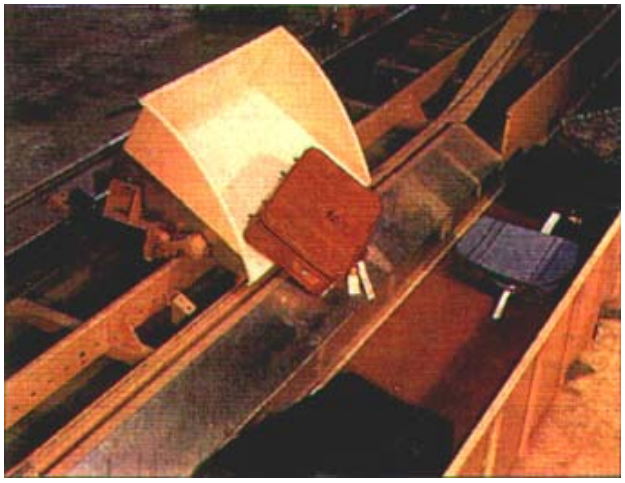
The System



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The Timeframe

- BAE started work 17 months before scheduled opening October 31, 2003
- In Munich (similar system), engineers had spent *two years* just *testing* the system (with 24/7 operation six months before the airport opened)

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More Risks

- Most of buildings were already done, so BAE had to accommodate system (sharp turns, narrow corridors…)
- BAE paid little attention to German sister project and devised system from scratch
- Little communication within BAE

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Final Blunder

- The decision to broadcast the preliminary test of the "revolutionary" new baggage system on national television

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While all of the previous blunders contributed to the failure of the system, the worst mistake was still yet to come. It was a decision so terrible, so foolish, so absolutely

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What camera crews depicted was truly a disaster; carts jammed together, damaged luggage everywhere, some bags literally split in half, and the tattered remains of clothing strewn

A Disaster

- Carts jammed together
- Damaged luggage everywhere, some bags literally split in half
- Tattered remains of clothing strewn about caused subsequent carts to derail
- Half the luggage that survived the ordeal ended up at the wrong terminal

More Issues

- Carts got stuck in narrow corridors
- Wind blew light baggage from carts
- 5% of the labels were read correctly
- Normal network load was 95%

Complexity: Empty Carts

- Empty carts need to go where they are needed
- Cart has to be at its "cannon" at the right moment
- Lanes have limited length → traffic jam
- All controlled by single central system

Consequences

- Airport opening delayed four times – overall, sixteen months late
- New engineering firm
  - split system in three (one per terminal)
  - implemented manual backup system
- BAE got bankrupt
- Overall damage: 1.3 bln USD

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Glass' Law

Requirement deficiencies are the prime source of project failures.

This and other laws are found in Endres/Rombach: Handbook of Software and Systems Engineering. Evidence: Denver airport case study and two more

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Chaos Report

- 31% of projects were *aborted* prior to completion
- in small (large) development companies, *only 16% (9%) of all projects* were completed within projected budget and time limits

Survey by the Standish Group, 1994 – 350 companies with >8000 software projects

http://www.standishgroup.com

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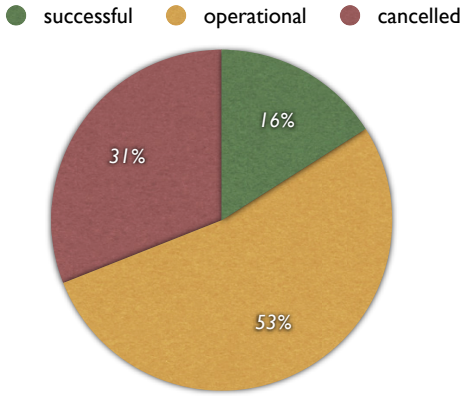
Project Success



Survey by PC week, 1995: 365 information systems professionals on success of software development projects

16% of all projects successful

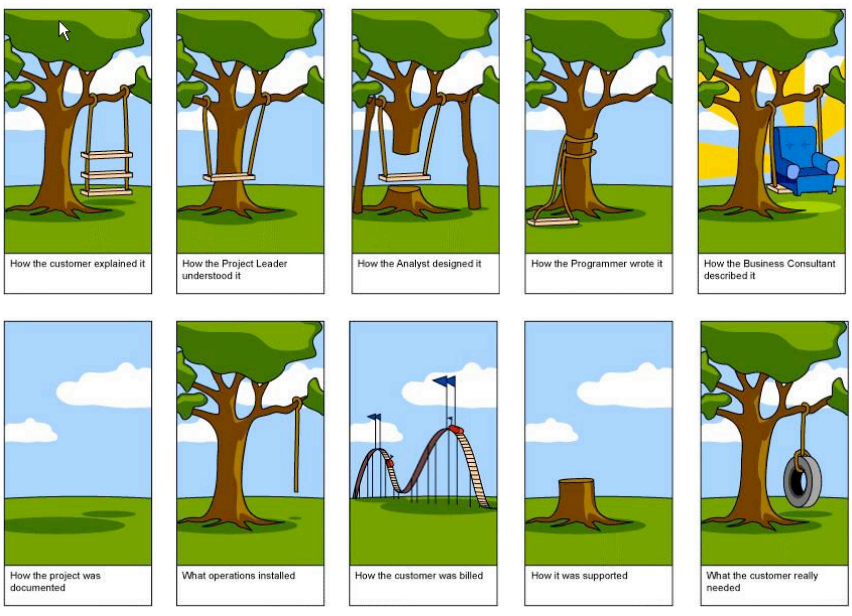
53% operational, but less than successful

31% *cancelled*

More Examples

- Mariner I (1962)
  Rocket crash due to missing dash
- Eole I (1971)
  72 weather balloons get wrong cmd
- Nimbus 7 (1978)
  Satellite misses ozone hole for 6 yrs
- HMS Sheffield (1982)
  Exocet rocket id'ed as "friend"
- Stanislaw Petrow (1983)
  Russia detects global nuclear attack
- Therac 25 (1985)
  Radiation overdose kills six
- Stock crash (1987)
  Dow Jones loses 22% in one day
- Vincennes (1988)
  Passenger jet mistaken to be F-14
- Patriot (1991)
  Misses to shoot down Iraqi Scud
- Climate Orbiter (1999)
  Confuses metrics and imperial
- US Blackout (2003)
  50 mln affected for 5 days
- Social support (2004)
  No money for millions

http://www.tagesanzeiger.ch/digital/computer/13-Softwarefehler-die-zu-Katastrophen-fuehrten/story/21703807



Challenges

- Why does it take so long to get software finished?
- Why are the development costs so high?
- Why can't we find all errors?
- Why do we spend so much time and effort maintaining existing programs?
- Why is it difficult to measure progress?

Topics

- Requirements Engineering
- Software Specification
- Software Design and Architecture
- Software Quality Assurance
- Software Maintenance and Evolution
- Software Project Management

Your Lecturers

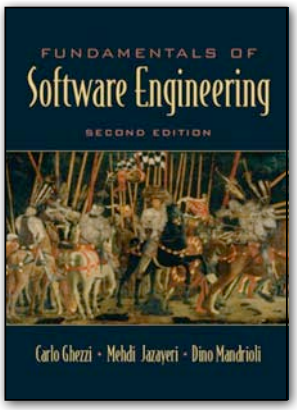
- Andreas Zeller
- Lecture Tue/Thu 16:15–17:45 HS2
- Irregular timing (see Web page)

Your Tutors

- Martin Burger (coordinator)

- Andrey Krekhiv
- Arif Khan
- Birgit Schwarz
- Dragana Majstorovic
- Erdal Kuzey
- Kausnik Mukherjee
- Mathias Bader
- Sameera Mahajani

Books



Exams

- Final Exam – mid February
- Extra Exam – mid March

Projects

- SW Engineering is best learned by *doing*
- Therefore, *projects* make up 2/3 of course

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Projects

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Client

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Team

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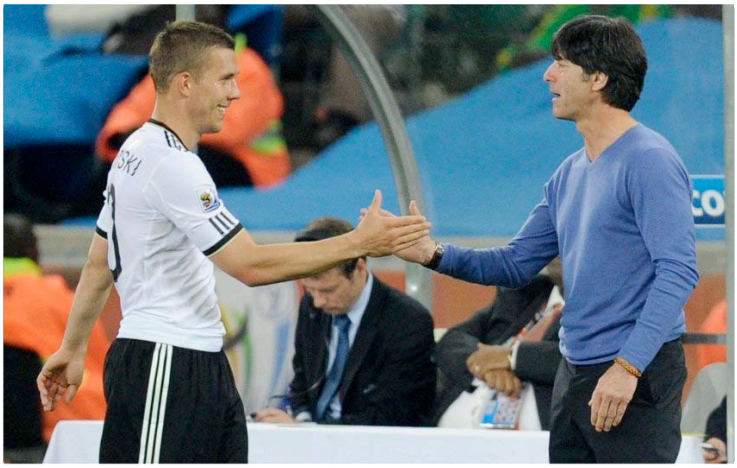
Tutor



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Supervision

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Honor

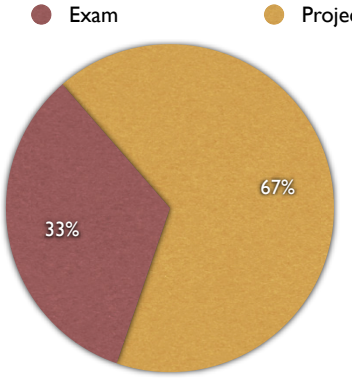
Project Details

- Non-trivial piece of software
- Suggested by *client* (a CS member)
- Client is *busy* (spends max 20 hrs total)
- Client is *vague* (on purpose)

Deliverables

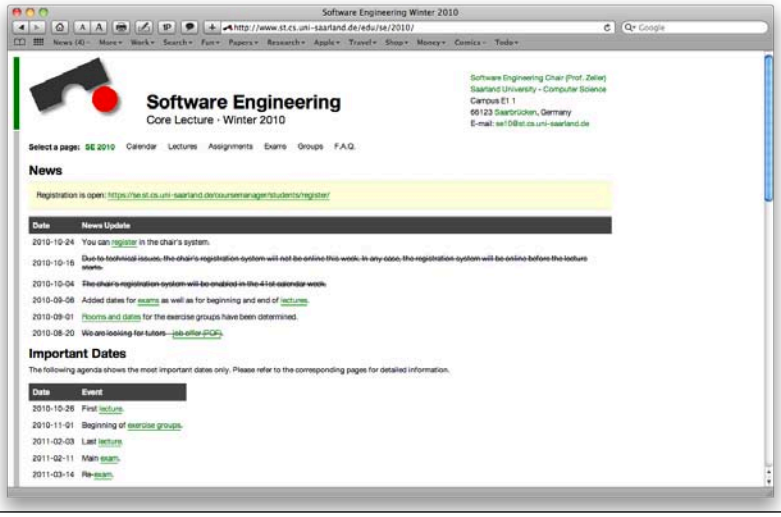
- Full set of *requirements*
- User interface design
- Architecture design
- Project plan
- Prototype

Grading

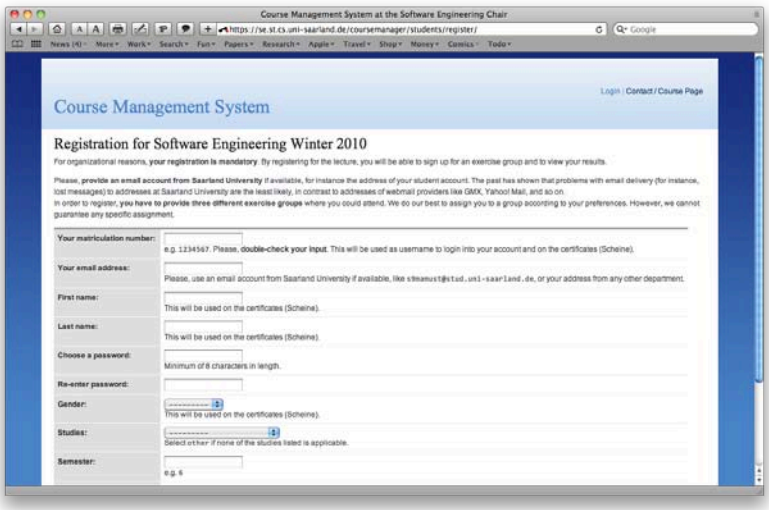


- Need to pass *both* exam and project to pass
- Project grades based on group performance (with bonus for individuals)

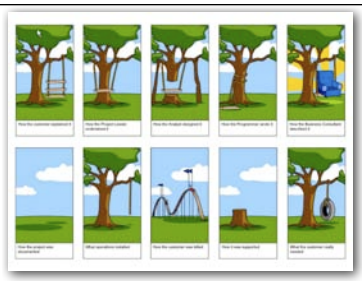
Web Site



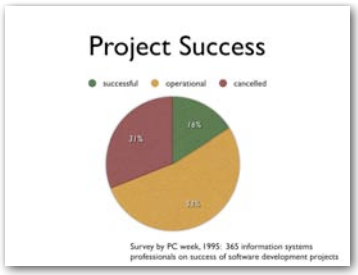
Sign up!




Software Engineering
Summer 2009



Summary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