Software Architecture, Process and Management Failures

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http://www.inf.ed.ac.uk/teaching/courses/sapm
Semester Two 2012-13
Let’s test your failure detectors

- Players (in all sports, but let’s take Basketball as an example) seem to score in ‘streaks’, giving rise to terms such as ‘hot hand’ and ‘in the zone’

- The following are sequences of basketball players’ attempts with X a score and 0 a miss, which one of these represents the sequence of a player “in the zone”?
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- Of course I’m lying they are all random, in the sense that there is no correlation between the outcomes of successive shots

  - 0XXX0XXX0XX000X00XX00X, of the 12 Xs,
  - 0XXX0XXX0XX000X00XX00X, 6 come after a 0
  - 0XXX0XXX0XX000X00XX00X, 6 come after a X
Humans are pattern matching creatures

Historically this has been good news for us; eat that plant \( \rightarrow \) get sick

But if we are not careful this tendency to look for an explanation can result in erroneous beliefs.

Failing to spot randomness, or seeing patterns from randomness is a good example of the tendency.

If you own an iPod, your “shuffle” feature is not entirely random, initially it was, but customers complained on non-random features.
London Bombings

![Graph showing longitude vs latitude for London Bombings]
London Bombings
London Bombings

\[ \text{chi-square value} = 14.559999999999999, \text{ probability} = 0.002 \]
London Bombings

chi-square value = 1.6, probability = 0.66
London Bombings

chi-square value = 1.52, probability = 0.68
Confirmation Bias

“\textit{I will look at any additional evidence to confirm the opinion to which I have already come}” — Lord Molson, British Politician (1903-1991)

- The confirmation bias, is possibly the single largest cause of failure. It exacerbates other cognitive biases
- It means that we disproportionately seek information/facts which will prove an existing theory rather than equally searching for facts that will disprove the theory
A study (carried out in the USA, and actually seeking to investigate perceived similarity) asked two groups of participants respectively:

- Which two countries are more similar to one another, East Germany and West Germany or Sri Lanka and Nepal?
- Which two countries are more different from one another, East Germany and West Germany or Sri Lanka and Nepal?

In the first group the majority said that East and West Germany were more similar to each other.

In the second group the majority likewise said that East and West Germany were more different from each other.
The Benevolent Dolphin Problem

- Dolphins are sometimes said to help humans who have fallen overboard (somehow)
- The dolphins seem to gently but firmly nudge the bewildered swimmer safely to shore
- Tempting to conclude that dolphins really really like humans and wish them to survive
- Are they actually trying to be helpful?
- Do they even know that humans aren’t good swimmers (in comparison to dolphins)
Dolphins saved us from shark, lifeguards say

By Ainsley Thomson
5:02 AM Wednesday Nov 24, 2004

By AINSLEY THOMSON

A pod of dolphins is being credited with saving a group of lifeguards from a circling great white shark.

Lifeguard Rob Howes, his daughter Niccy, 15, Karina Cooper, 15, and Helen Slade, 16, were swimming 100m out to sea at Ocean Beach, near Whangarei, when seven bottlenose dolphins sped towards them and herded them together.
The Benevolent Dolphin Problem

- The dolphins may just be being playful, nudging the beleaguered swimmer aimlessly.
- To know, we’d have to know how many shipwrecked sailors had been gently nudged out to sea.
- But of course we never hear from those.
- Hence the only evidence we ever hear is in confirmation of theory of altruistic human loving dolphins.
The Benevolent Dolphin Problem

Playful dolphin strands NZ woman

A New Zealand swimmer got into difficulty when a friendly dolphin stopped her returning to shore.

The woman had been swimming with the dolphin, called Moko, at Mahia Beach on the North Island. But the playful dolphin did not want the fun to end.

People at a nearby cafe eventually heard her cries for help, and rowed out to her rescue.

She was found, exhausted and extremely cold, clinging to a buoy. She said the dolphin had meant no harm.

The woman, who wanted to remain anonymous, was wearing a wetsuit. But even that eventually failed to protect her from the winter cold.

Panic
Plane Crashes

- A popular trivia tid-bit goes like this: “80% of airplane crash survivors had studied the locations of the exit doors upon takeoff”
- Are we convinced? What about the non-survivors, no reported data
- It could be that 100% of non-survivors studied the locations of the exit doors
- Or more likely, 80%
- It could be that those that study the exit locations also keep their seat-belts fastened or any other of a number of safety precautions
Other Failures

- Cognitive Dissonance — fancy way of saying conflict of mind
- Over confidence
  - 90% of drivers are better than average
  - Recall your attempts at 90% estimating accuracy
- Our faulty/efficient memories
- Sunk cost fallacy
Choice Pyramid

- Confirmation Bias
- Forget disconfirming evidence
- Cognitive Dissonance

Mistake

Correct
Recall: Criteria for Success

- The software is delivered on schedule
- Development costs were within budget
- The software meets the needs of users, in both:
  - scope and
  - quality
NHS Connecting for Health

- “Originally expected to cost 2.3bn GBP over three years, in 2006 the total cost was estimated ... to be 12.4bn over 10 years...”

- “Officials ... estimat[ed] the final cost to be as high as 20bn, indicating a cost overrun of 440% to 770%...”

- “This is the biggest IT project in the world and it is turning into the biggest disaster.” ... despite a probable expenditure of 20 billion pounds “it is unlikely that significant clinical benefits will be delivered...”
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2010 World Bank ranking of 190 countries by GDP
£12bn NHS computer system is scrapped... and it's all YOUR money that Labour poured down the drain

- Sum would pay 60,000 nurses' salaries for a decade
- Scheme replaced with cheaper regional alternatives
- Decision comes after report said IT system was not fit for the NHS

By DANIEL MARTIN
UPDATED: 18:08, 22 September 2011
Claims of Catastrophic Failure

- You should of course be skeptical of anything that claims 12bn has been wasted
  - My own personal views on the The Daily Mail aside
- Other sources were more sober, it seems that there is a move to decentralisation allowing for local NHS trusts to make appropriate local decisions rather than imposing a top-down system
- However, the announcement was described as “an acceleration of the dismantling of the National Programme for IT”
- Sir David Nicholson “The NPfIT has provided us with a foundation but we now need to move on if we are going to achieve the efficiency and effectiveness required in today’s health service”
- So whilst the entire 12bn cannot be written off as entirely wasted it is also quite clear that the project, by our criteria, is an abject failure
Why Software Projects Fail

- Software appears, by its nature, to be difficult to engineer on a large scale.
- Nevertheless, there is an insatiable demand for sizeable, well-engineered software.
- We continue to be dogged by large numbers of project failures, on small and large projects.
- Many (most?) of these are due to mistakes in project management.
- We include going over budget and past scheduled delivery date in our definition of failure.
  - However we have seen in previous lectures that this is often due to an inability to estimate the cost and time required for a project in the first place.
  - So in the lecture we will mostly be discussing projects which fail to deliver quality software.
  - Most times the entire system is scrapped with no discernible project deliverable outcomes.
Scale of the Problem

- 1994 Standish report, for the failure criteria in this course:
  - 91% of projects at large companies failed
  - 30% of projects at large companies were eventually cancelled
- Overall project failures (as defined in this course) per year, from Standish figures:
  - 1994: 84%
  - 1996: 73%
  - 1998: 74%
  - 2000: 72%
  - 2002: 66%
  - 2004: 71%
  - 2009: 68%
- Clearly, when starting a project, one can expect it to fail
FBI: Virtual Case File

- The US Federal Bureau of Investigation has often been criticised for not sharing leads between agents and divisions.
- Just before the 2001 terrorist attacks, the FBI hired Science Applications International Corp (SAIC) to develop Virtual Case File software (VCF).
- VCF was designed to manage case files electronically, so that any agent with suitable permissions can find relevant information.
- Originally scheduled for completion in 2003.
FBI: Virtual Case File

- After repeated delays, a version was delivered in December 2004, but:
  - Was about one tenth of originally promised
  - Was eventually scrapped altogether
  - Does not approach functionality of existing commercial packages
  - Used as an extremely expensive prototype
  - About $170 million wasted
FBI: Virtual Case File

- Apparent causes:
  - Changing requirements (after the September 11 attacks)
  - Ambitious project, run as an emergency fix
  - 14 different managers over project lifetime
  - Poor oversight of external contractor
  - Not paying attention to new, better commercial products
  - Hardware purchased already; waiting on software
Supply Chain Management

- **Background**: Supply chain management crucial in price war between Sainsbury’s and Tesco
- **pre-2000**: Sainsbury’s had “mainframe-based warehouse management system”; “400 different supply chain software applications”
- **2000**: new CEO Peter Davis authorised outsourcing IT to Accenture, aiming to get an “agile IT infrastructure built on an open, adaptive, scalable architecture with hardware and software systems that would give very high performance, strong data security, and low total cost of ownership.” — Key supplier Sun.
May 2004:
- “The $1.8 billion overhaul is well under way, and will be completed in 2005.”
- “The relationship with Accenture has worked so well that Sainsbury’s has chosen to extend its IT outsourcing contract for another three years, until 2010 — a move that should allow the retailer to net additional cost reductions of more than $230 million by 2007.”

July 2004: Davis resigns — poor financial performance

October 2004:
- New system unable to track stock correctly
- Shops go short
- Sainsbury’s recruits 3000 shelf stackers to handle crisis, writes off $260m IT spend, renegotiates contract with Accenture
- Accenture blames poor reliability of four fully automated depots, not covered by their agreement
- new Sainsbury’s CEO Justin King blames Accenture

October 2005: Outsourcing cancelled, IT brought back in house
Apparent causes of problems with the Accenture attempt:

- Weak outsourcing governance
- Loss of staff with knowledge about legacy systems
- Risky “big bang” approach
- Political in-fighting
- Generally poor business management

Main source: Douglas Hayward in a 2005 silicon.com article
Customer Database System

- In 1996 a US consumer group embarked on an 18-month, $1 million project to replace its customer database.
- The new system was delivered on time but didn’t work as promised, handling routine transactions smoothly but tripping over more complex ones.
- Within three weeks the database was shut down, transactions were processed by hand and a new team was brought in to rebuild the system.
Problems:

- The design team was over-optimistic in agreeing to requirements
- Developers became fixated on deadlines, ignoring errors
Customer Tracking System

- In 1996 a San Francisco bank was poised to roll out an application for tracking customer calls.
- Reports provided by the new system would be going directly to the president of the bank and board of directors.
- An initial product demo seemed sluggish, but telephone banking division managers were assured by the designers that all was well.
- But the system crashed constantly, could not support multiple users at once and did not meet the bank’s security requirements.
- After three months the project was killed; resulting in a loss of approximately $200,000 in staff time and consulting fees.
SAPM: Customer Tracking System

- Problems:
  - The bank failed to check the quality of its contractors
  - Complicated reporting structure with no clear chain of command
  - Nobody “owned” the software
Payroll System

- The night before the launch of a new payroll system in a major US health-care organisation, project managers hit problems.
- During a sample run, the off-the-shelf package began producing cheques for negative amounts, for sums larger than the top executive’s annual take-home pay, etc.
- Payroll was delivered on time for most employees but the incident damaged the relationship between information systems and the payroll and finance departments, and the programming manager resigned in disgrace.
Problems:
- The new system had not been tested under realistic conditions
- Differences between old and new systems had not been explained (so $8.0 per hour was entered as $800 per hour)
- “A lack of clear leadership was a problem from the beginning”
Systems of Systems

- A key component in many of these large software failures is that of integration
- Integration appears to be more challenging than original work
- Despite these, often very visible failures, there appears to be no let up in demand for such “megasoftware”
Warning Signs

- Organisation: hostile culture, poor reporting structures
- Management: over-commitment, political pressures
- Conduct of the project:
  - Analysis and design phase:
    - poor consultation
    - design by committee
    - technical fix for management problem
    - poor procurement
  - Development phase:
    - Staff turnover
    - poor competency
    - poor communication (e.g. split sites)
  - Implementation phase:
    - receding deadlines
    - inadequate testing
    - inadequate user training
Reasons for Failure

- Unrealistic or unarticulated project goals
- Inaccurate estimates of needed resources
- Badly defined system requirements
- Poor reporting of the project’s status
- Unmanaged risks
- Poor communication among customers, developers, and users
- Use of immature or outdated technology
- Inability to handle the project’s complexity
- Sloppy development practices
- Poor project management
- Stakeholder politics
- Commercial pressures
Most of these aren’t specifically developer issues

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Irrational Project Escalation

- This is caused when, despite all indications to the contrary a project is allowed to continue or even "stepped up".
- The national audit office reported numerous cases of government IT projects proceeding despite a recommendation to halt.
- The UK even has a government department whose one job is to prevent IT failures.
  - Unfortunately, more than half of the agencies the department oversees routinely ignore its advice.
- For me this is quintessential cognitive dissonance behaviour.
  - The project cannot be doomed to failure or the last 5 years of my work has been an entire waste, and I was stupid not to see it coming.
  - I didn’t see it coming therefore it must not be coming.
  - Ignore the evidence I don’t like and consume with glee the evidence that tells me the project will succeed.
The Daily WTF

- [http://thedailywtf.com](http://thedailywtf.com), worse than failure, what to fix or, etc.
- Humourous take on mostly technological/developer failure
- Today’s story however focussed on management error:
Tim’s Day

► Tim (a developer) arrives at work and see his boss on the phone to their company’s largest customer SuperMegaFoods
► Eventually the CEO of SuperMegaFoods is handed down to Tim
► “YOU IDIOTS DONT KNOW WHAT YOURE DOING!” , “We have a huge sale starting and you broke our website!”
► A massive now e-commerce sale with 100 000 fliers printed showing a URL which currently pointed to an error
► Tim brought up SuperMegaFoods on the content management system, but he could not find any work order for this initiative
► He explained to the CEO of SuperMegaFoods, who replied “Thats impossible! You buffoons screwed the pooch and don’t want to own up to it! I’m going to get one of my marketing people in here, he’ll show me the request, and I’ll have you in a vice!”
Tim’s Day

- 15 minutes later
- “I must sincerely apologize. Nobody downstairs ever actually sent in an order for this new web stuff”
- This was one the development company really couldn’t accept any blame for
Summary

- Software development is inherently a risky process
- Some level of failure is required to keep making technological and economic progress, but the failure rate of software projects is too high
- Many projects fail for the same reasons and there seems to be little or no prejudice, commercial, non-profit, government, all countries, etc.
- Unfortunately, hindsight is much clearer than foresight, but
- The risk of failure should be addressed from the very start
- A large part of the purpose of this lecture then is more as motivation for our next lecture on risk management
Required Reading

Suggested Reading
### Scotland vs Ireland

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*Slight disclaimer, data by Accenture, the same company involved with Sainsbury’s described above*
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Sometimes, when everything does go wrong, you somehow succeed anyway
Any Questions?

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