Systems Design: An Introduction

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MIS515

Credits: Material for the slides has been drawn from several sources including http://ocw.mit.edu/6/6.170/f01/index.html (Profs. Daniel Jackson’s and Srinivas Devadas course in laboratory in software engineering at MIT, Boston), Object Oriented Systems Development using UML by Bahrami, Irwin-McGrawHill)

Systems Design, An Introduction
Why SE is important?

- Greatest trade surplus of exports
- $24B exported, $4B imported, $20B surplus
- Compare with Agriculture (26-14-12), Aerospace (11-3-8), vehicles (21-43-(22))

(Source: Software Conspiracy, Mark Minasi, McGraw Hill 2000)
Why SE is important…

- Pervasive in embedded devices (10-100 in automobiles)
- Ratio of Cost of hardware/software acquisition is approaching “0”
- Total cost of Ownership: About 5 times cost of hardware
Software: How good is it?

- Failed development efforts, Accidents, Poor quality
  - Development Failures
    - IBM Survey, 1994
      - 55% of systems cost more than expected
      - 68% overran schedules
      - 88% had to be substantially redesigned
    - Advanced Automation System (FAA, 1982-94)
      - Industry average was $100/line expected to pay $500/line
      - Ended up paying $700-900/line
      - $6B worth of work discarded
      - 1/3rd of all systems put into operation are cancelled
      - Probability of cancellation > 50% for largest systems
      - Average project overshoots schedule by 50%
      - 3/4th of all systems are regarded as ‘operating failures’
– Accidents

“The most likely way for the world to destroyed, most experts agree, is by accident. That’s where we come in. We’re computer professionals. We cause accidents.”


– Ariane-5 (June 1996) – European Space Agency lost unmanned aircraft

– Software Quality

• Bug density
• Need for a change in perspective – a synthesis of conformance, adaptation, and innovation
Why Design Matters?

Quality begins at design

- Role of design and designers
  - Thinking in advance always helps
  - Adding quality at the end is an illusion, more effective than testing, much cheaper
  - Makes delegation and teamwork possible
  - Design flaws effect user: incoherent, inflexible and hard to use interface
  - Design flaws effect developer: poor interfaces, bugs multiply, hard to add new features

(we will see an example of how even simple concepts of design can have dramatic impacts in the Redesigning Air Traffic control example)
The Netscape Story

Myth: Design is unimportant because time-to-market is all that matters

- Original NCSA Mosaic team at UI built the browser – widely used but poor design
- Netscape founded 1994, released Navigator 1.0
- Microsoft developed IE 1.0 in Oct 94, shipped with Windows in Aug. 1995
- 1995-97 Netscape’s growth period marked by adding of features less/no focus on design
- Meantime Microsoft realized the need for solid design.
  - Built NT from scratch, restructured office suite
  - Hurried to deliver IE to catch Netscape but took time to restructure IE 3.0
- Netscape 4.0 120 developers (from 10), 3 million LOC (up by a factor of 30)
  - Mike Toy, release manager “We’re in a really bad situation...We should have stopped shipping this code a year ago. It’s dead...This is like the rude awakening...We’re paying the price for going fast.”
- Netscape has made several attempts since then to re-architect the browser but it was a bit too late. (it took them 2 years to know the importance of focusing on design fundamentals)