Real World System Development

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#1 Terps
Does not include...

• Educational research projects
• App development
• Open source development (although some elements are the same)
In the beginning...

• The customer issues a “Request For Proposal”
  – Describes in varying level of detail what they want
Contractor responds with a Proposal

- Proposal content complies with the RFP (mostly)
- Usually includes a Management Volume, Technical Volume and Cost Volume
- RFP preparation is intense
Winner is announced

Loser may decide to lodge a formal protest
Development Methods

• Waterfall
  – Requirements are detailed
  – Systems built to satisfy requirements
  – System tested against requirements
  – System delivered to Customer

• Agile Methods
  – Iterative; all requirements not detailed up front
  – Customer gives feedback during development
Phases include

- System Architecture
- System Design
- Software Design
- Software Development
- Many testing levels
- Delivery
Requirements

• System requirements decomposed into several “levels”
• Traceability between levels is maintained
• Automated tools needed for large systems with 1000s of top level requirements
• Requirements are mostly documented as “shall”; there is an art to writing good requirements
System Reviews

• Architecture is usually included in proposal
  – Customer may give feedback upon award

• Preliminary Design Review (PDR)
  – System partitioning and decomposition of requirements is the focus
  – MilStd term for decomposed units is “Computer Software Configuration Item” (CSCI)

• Software Design Review (SDR)
  – Given PDR partitions, next level of decomposition
  – No software code yet
Software Development

• Starts with the Design from SDR and allocated requirements

• Done in the context of the software architecture
  – E.g., “a three tier web architecture using an SQL database”

• Highly dependent on the programming language(s) selected and infrastructure available
Elements of SW Development

• Requirements mapping
• Inspections
  – A review of the end product (code, configuration data, etc) by others
  – May be done in a room or virtually
• Initial testing
  – Intended to make sure individual pieces work before putting them together
Other SW Development topics

• “Test Driven Development”
  – Write the test cases first, before writing code
  – Generally the development infrastructure would assist in running and recording the results of testing

• “Pair Programming”
  – One of the Agile Development concepts
  – Two people work side-by-side (one keyboard and screen) to develop the code
• Code Style Guides
  – Meant to ensure common conventions followed for the source code
  – Enables an easier understanding by other team members

• Static Analysis
  – Before inspection, tools run on source code
  – Check that style is followed, and catch other potential bugs
• Source code configuration management (CM)
  – Is needed from the start
  – Generally, a “committed” baseline is maintained that the developers think works
  – CM allows changes to be easily backed out
  – Becomes even more important when managing several releases
Testing Levels

• Unit Tests
  – First level of software tests
  – Want to ensure all paths through the units are covered by tests; tools may report on coverage

• Software Integration Tests
  – Test CSCI level integration (if possible)
  – Initial testing against requirements
More testing

• System Integration Tests
  – Puts CSCIs together
  – May include automation for running tests, keyboard simulators, etc.
  – Requirements are tested

• System Sell Off Tests
  – Witnessed and certified by the customer
  – Significant payment upon completion
Specialized Tests

• Max Stress Workload
  – Ensure that the agreed to loads, number of users, etc. can be handled

• Long Duration Tests
  – May need to run the system for days
  – Good for catching memory leaks

• Cutover tests
  – For systems that must be updated in real time
Maintenance

• Many releases may be maintained concurrently
  – Fielded
  – About to be fielded
  – In development

• Significant effort needed to keep track of what’s in each release
  – Especially as bugs are reported from the field; do they need to go into the next release, or get fixed immediately
More Maintenance

• Tools and databases are needed to keep track of it all
  – Issues (bugs), Features (new in next release) are mapped to:
    • Requirements
    • Releases
    • Software Units
    • Various tests
  – “JIRA” is a popular tool for this
Conclusion
Research in Industry

• Companies with mega-bucks can afford to do moon-shot projects
  – Used to be AT&T, IBM
  – Now Google, Facebook

• Government contractors are contractually allowed to spend a certain amount on research
  – Each project is evaluated with the potential impact on the bottom line