The Cataract Methodology for Systems and Software Acquisition

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Topics

- The current paradigm
- Methodologies
- The Cataract Methodology
- From the Cataract perspective
- Results in the academic environment
- Questions, comments and discussion

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Current paradigm

- Cost and schedule overruns
- Failures
- Systems that don't meet the customer's needs
- International situation
  - CHAOS
  - OASIG

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Lessons learned

- **Programs do not fail* because the requirements change.**
  - Tasks, products and processes exist
- **Programs fail* because of poor requirements engineering management**
  - failure to reevaluate requirements in the context of
    - changes in needs
    - changes in technology
    - changes in paradigm
      - air power and battleships
      - guided ordnance and surface ships

* [cancelled] or [incur > 60% (cost or schedule) over-runs]

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Conventional wisdom

- Waterfall approach does not cope well with changing requirements.
- Change the production process from the waterfall approach to some type of rapid, spiral, or other methodology
- Result
  - Not much of an improvement.

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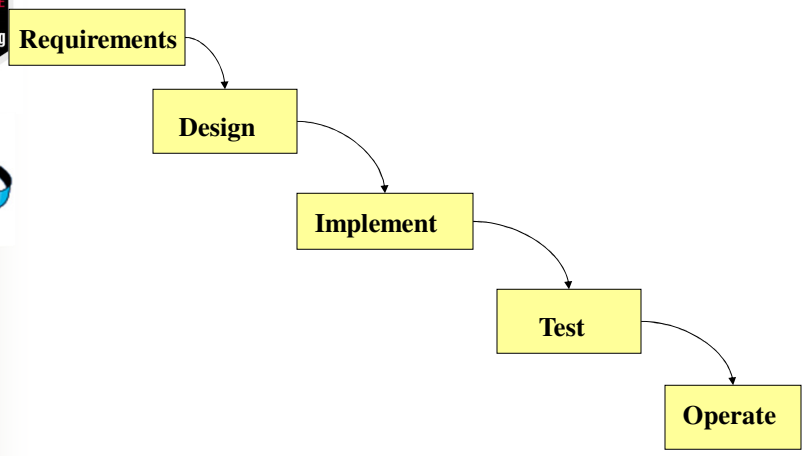
Waterfall methodology



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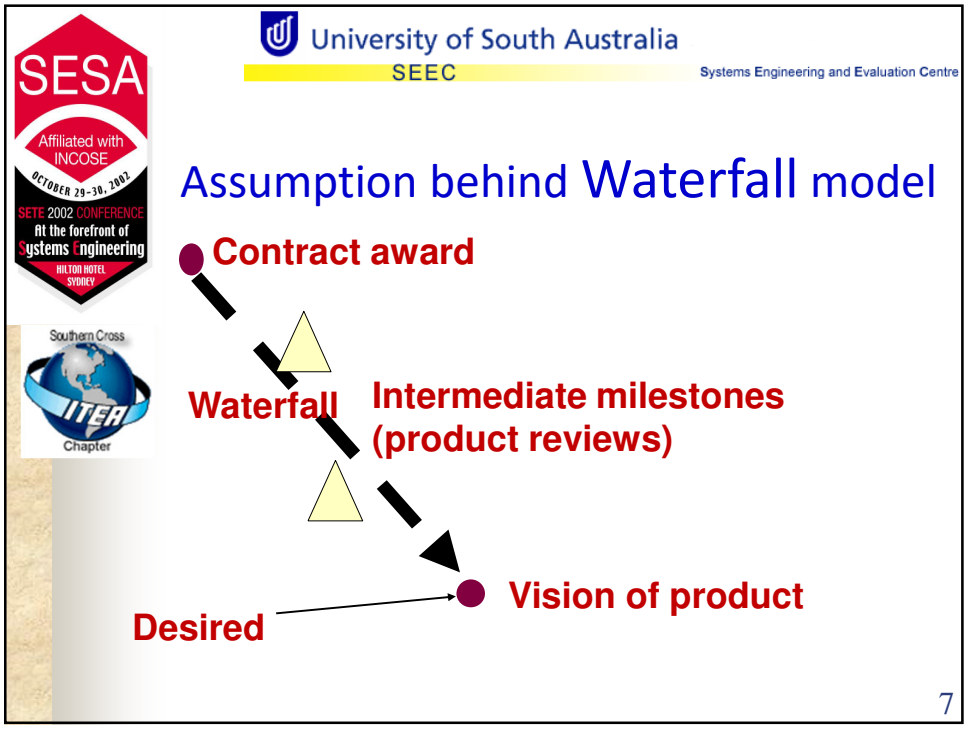
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Chapter
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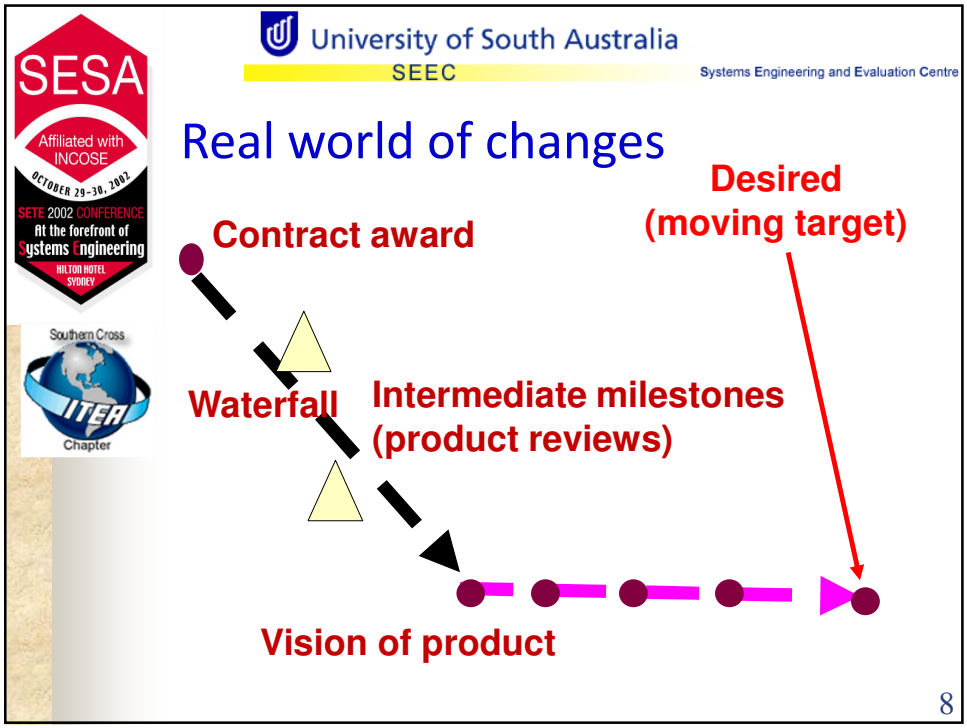
Assumption behind Waterfall model
Contract award
Waterfall
Intermediate milestones
(product reviews)
Desired
Vision of product
7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Real world of changes
Desired
(moving target)
Contract award
Waterfall
Intermediate milestones
(product reviews)
Vision of product
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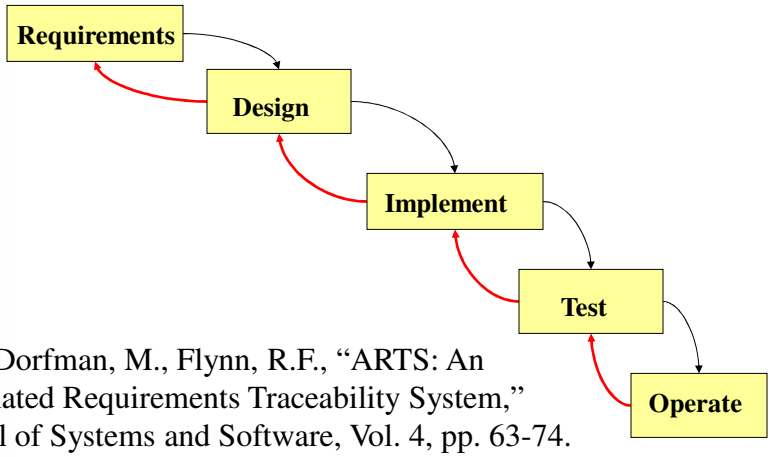
Waterfall - modified view



1984, Dorfman, M., Flynn, R.F., "ARTS: An Automated Requirements Traceability System," Journal of Systems and Software, Vol. 4, pp. 63-74.

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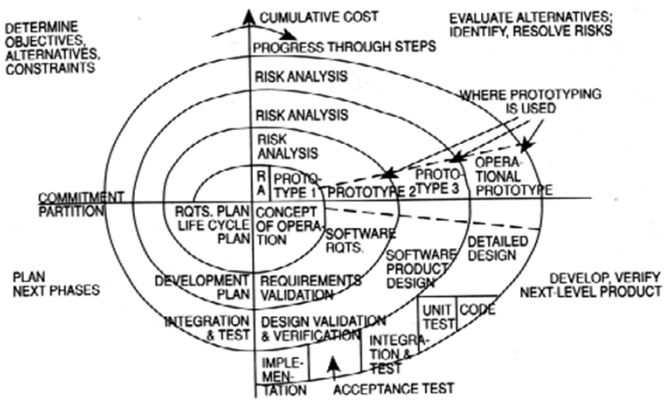
Spiral methodology



Yourdon (1992), *Decline and Fall of the American Programmer,* p. 101

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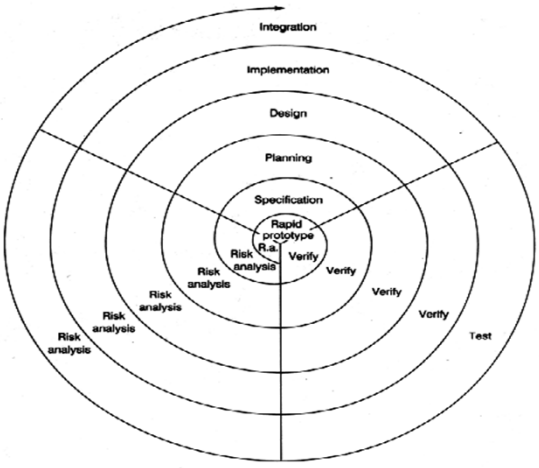
Simplified Spiral Model



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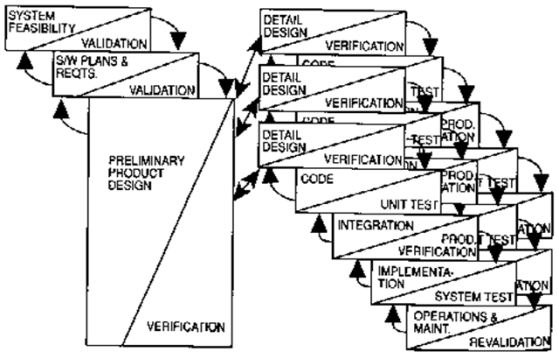
Incremental Build Life Cycle



Yourdon (1992), *Decline and Fall of the American Programmer,* p. 100

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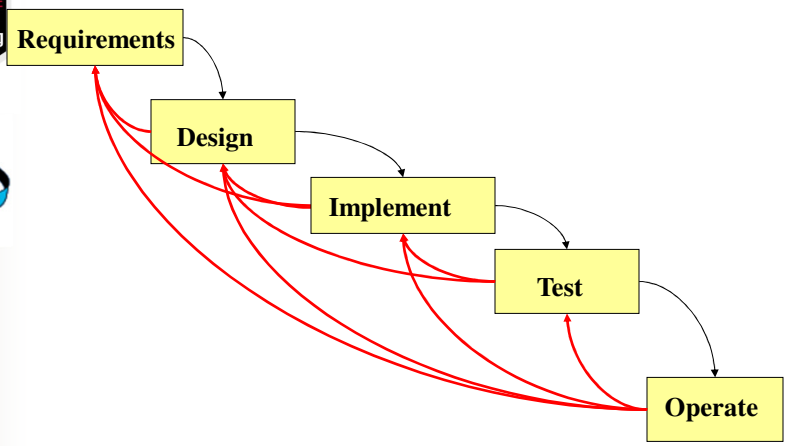
Waterfall - chaotic view



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Goal of systems engineering

- **Meets the customer's requirements** as stated
  - when the project starts.
  - as they exist when the project is delivered.
- Is flexible enough to allow cost effective modifications to be implemented as the **customer's requirements** **continue to evolve** during the operations and maintenance phase of the system life cycle.

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Cataract methodology

- Extends the spiral approach **allowing for system evolution** by emphasizing
  - **Configuration management**
  - the type of information needed to control system and software development in an **integrated engineering and management** environment
- Assembled from proven parts of other methodologies

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Cataract methodology

- The waterfall methodology **works very well over a short period of time**
- Implementation and delivery of systems and software are often performed in "**Builds**"
  - each successive Build provides additional capabilities.

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The Cataract methodology

- **Is an integrated** product-process methodology
  - **engineering and management**
- Depends on a new generation of tools and information displays such as the QSE, FREDIE, and CRIP charts.

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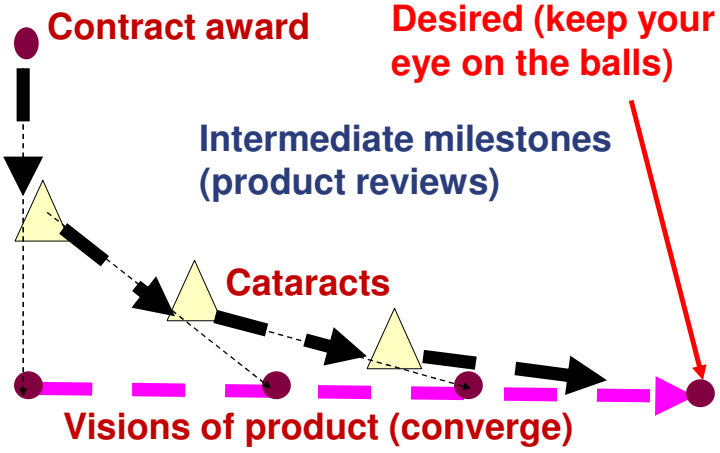
Assumptions behind Cataract model



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Change management

- Manage change to achieve convergence between
  - the needs of the user and
  - the capability of the as-built system

  in a cost-effective manner

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Changes

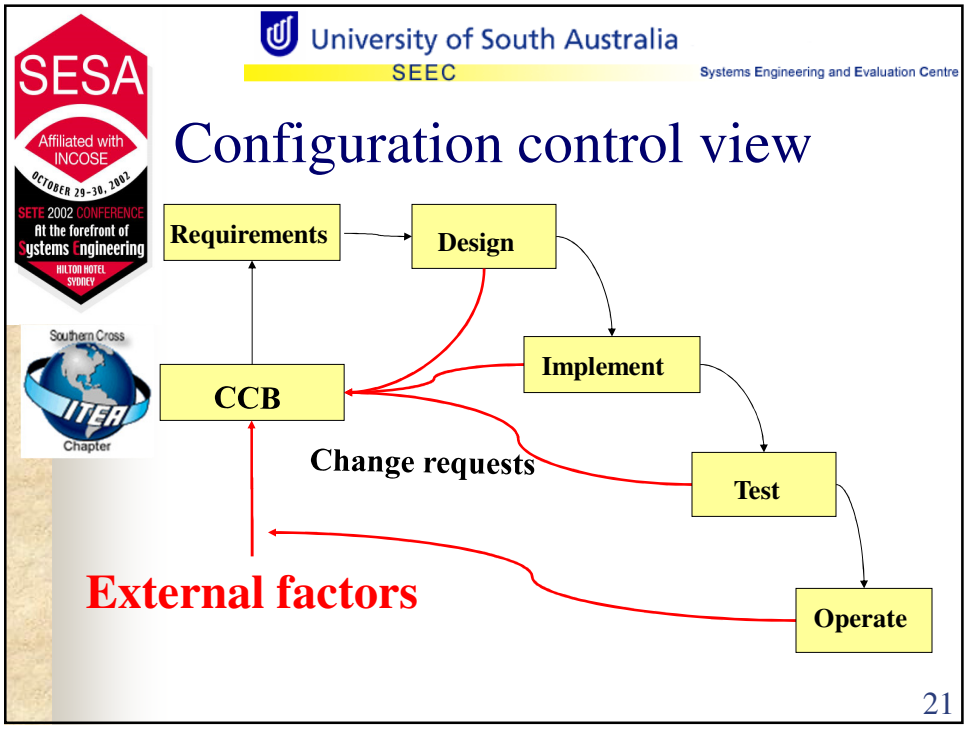
- Planned
- Unplanned

- Urgent
- Not so urgent
- Whenever

• Changes are managed via a

• change processing process

• under CCB control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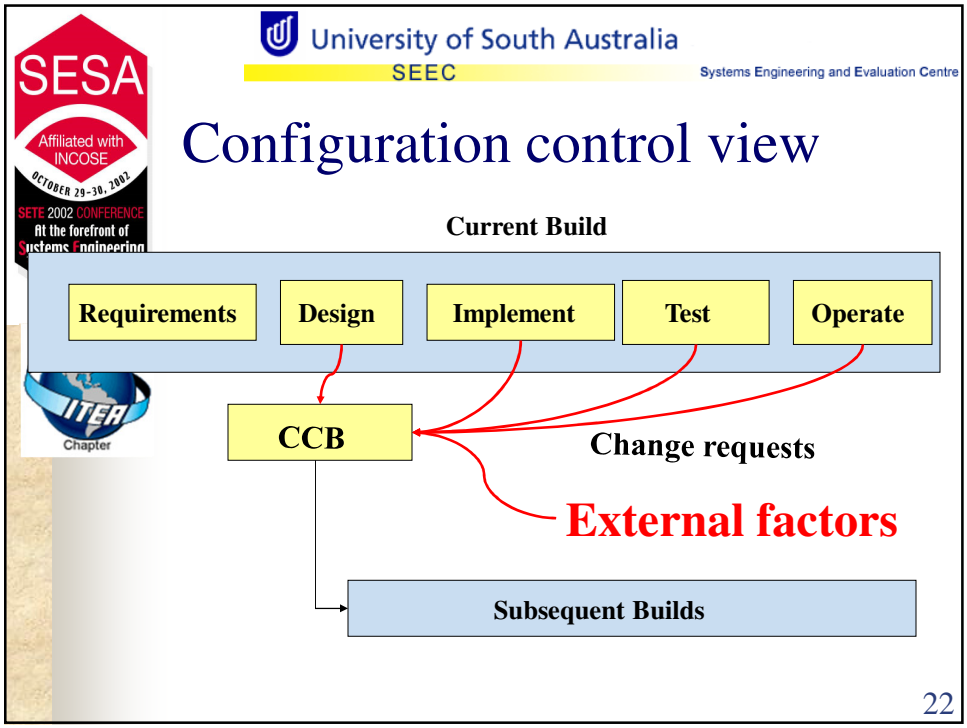
Chapter
Configuration control view
Requirements
Design
Implement
CCB
Change requests
Test
External factors
Operate
21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Chapter
Configuration control view
Current Build
Requirements
Design
Implement
Test
Operate
CCB
Change requests
External factors
Subsequent Builds
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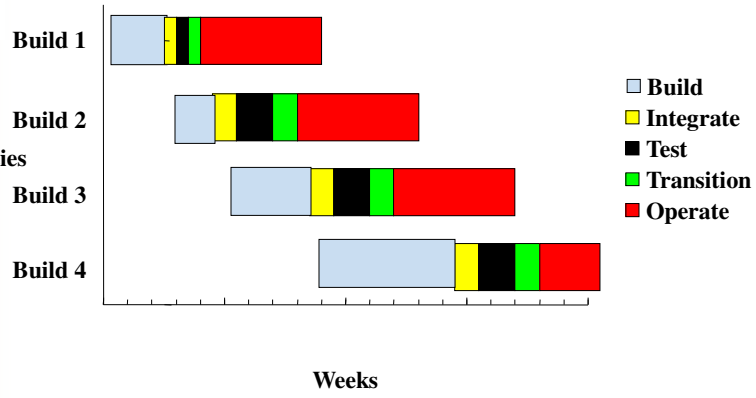
Phased Build Planning

Fig 17.1



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The cataract approach to Build Planning

- Rapid Prototyping scenario within the spiral
- The requirements for each Build are frozen at the start of the Build
- Build 0 precedes SRR
  - Once the initial set of requirements has been signed off, the system architecture designed, and the implementation allocated into a series of Builds,
- The implementation phase contains the Subsequent Builds embodying the cataracts

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Build planning

- Build 0
  - Initial requirements and architecture design
- Recognition that
  - All the requirements are not finalized at SRR.
  - Additional requirements will become known as the project progresses.
  - Design and implementation decisions
    - will be deferred and made in a just in time manner
    - maximize the "don't care" situations

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Build Zero is to - 1

- Identify the highest priority requirements.
- Baseline an initial set of user needs and corresponding system requirements.
- Develop the QSE for each of the baselined requirements
- Complete the first draft of the SEMP and OCD
- Design the Architecture Framework for the system in accordance with the DERA Reference Model

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Build Zero is to - 2

- Perform risk assessment to determine the proposed Architecture Framework can meet **all** of the highest priority requirements.
- Document the assumptions
  - driving the Architecture Framework
  - a representation of operational scenarios that the Architecture Framework prohibits
- Develop the WBS to
  - level the workload across the future Builds
  - Implement the highest priority requirements in the earlier Builds

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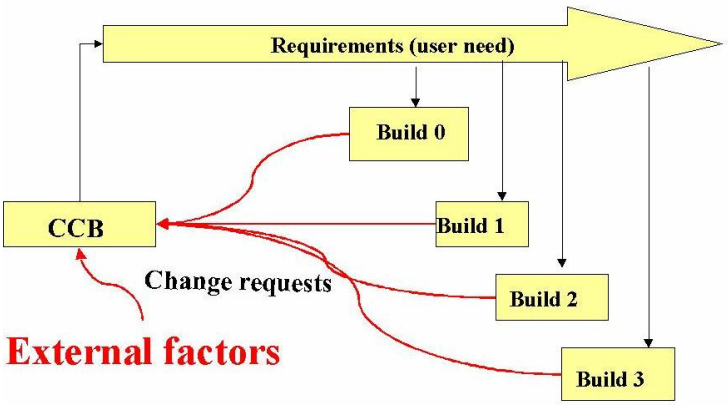
Cataract view



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Builds

- Incremental
- Evolutionary
- Revolutionary
  - an entire replacement system can be factored into the schedule.
  - Legacy systems can be upgraded and replaced with minimal waste of resources
    - By knowing when parts of the system will be replaced (in which Builds), informed decisions can be made as to
      - which defects to fix in the current system
      - which modifications to make, and which to defer to the replacement system.

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The key to effective control

- Effective configuration control
- informed decisions about the impact of any change request on the product (capability) and process (cost and schedule)
- knowledge management

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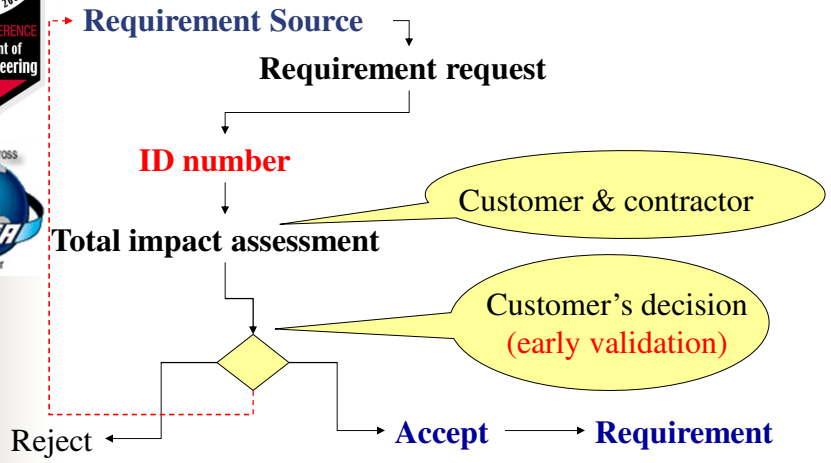
Requirements processing



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Impact assessment

- Prioritize the requirement
- Determine if a contradiction exists
- Estimate cost to implement
- Determine cost drivers
- Perform sensitivity analysis
- **Negotiate requirement with customers based on sensitivity analysis**
  - Are cost drivers really necessary?
- Document decisions in requirement repository

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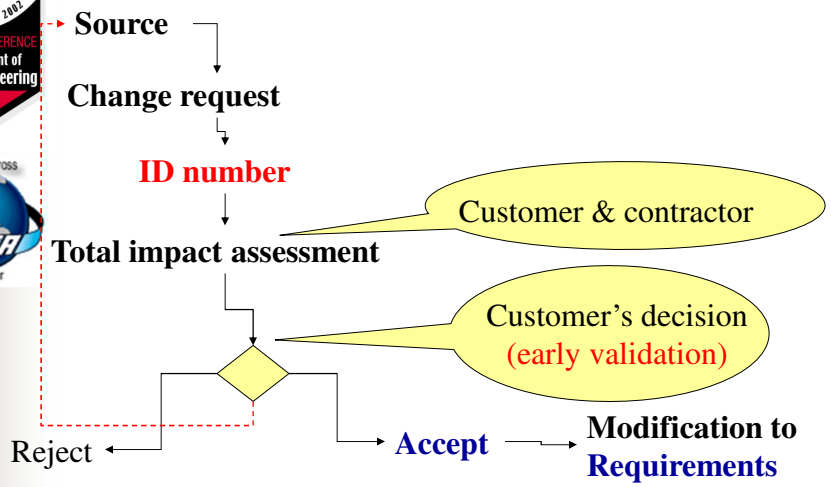
Change request processing



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From the cataract perspective

- Major contributors towards the current cost and schedule escalations and project failures are
  - The poor management of the
    - multi-phased,
    - Time-ordered,
    - parallel activities,
    - the lack of information that precludes informed decisions about the impact of the decisions

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From the Cataract perspective

- Y2k was just a Discrepancy Report (DR) and changes made as a result of the analysis of the problem.
- Effective configuration control and information about the state of the project is vital.

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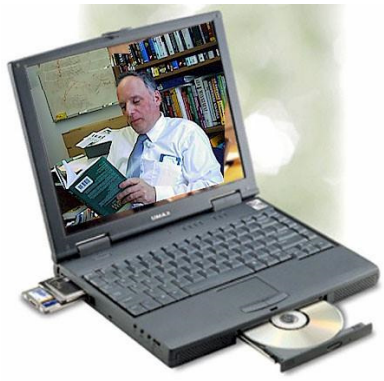
Examples from academia

- Several student projects per class of MSWE 617 at UMUC
- 14 week semester
  - Entire life cycle
- 2 Semesters
  - S1 1999
    - Face to face
  - S2 2000
    - Distance mode
    - Face to face



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UMUC MSWE 617

- Capstone course in the MSWE program
  - A comprehensive examination covering the application of the tools, skills and techniques the students have acquired in the course of their studies
- Provides experience in applying software-engineering techniques
  - an opportunity to produce software working in teams
  - under the schedule constraints commonly experienced in industry
- The instructor
  - emulates the vagueness shown by typical customers in describing requirements
  - serves as a guide and mentor, not as a traditional teacher
  - Guided the students through Build's 0 and 1 of the Cataract methodology

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Products

- **Review packages**
- Project management plan
- Software requirements document
- Test plan
- Software design document in presentation format
- Test procedures
- Software programmer's manual
- Application user manual
- Source code
- Test reports
- Management reports
- Installation instructions
- **Working application software**.

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14/15 week schedule

- **Kick off meeting**
- **OCR**
- **SRR**
- **PDR**
- **CDR**
- **DRR**
- **CAT**

see syllabus

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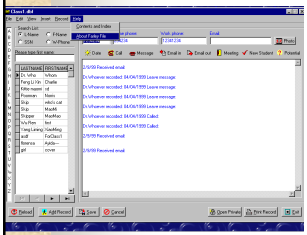
Farleyfile - (1999)

- Allows program directors to share information over a LAN
  - what they had told students
  - what students had told them
    - Emails, phone messages text
- Access students by
  - Name or ID. number
- Photographs of the students



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Deskcopy (2000)

- A web accessible book database
- Gathers the most recent textbook information via links to publisher's web sites
- Creates an electronic desk copy order form
- Monitors the state of the books ordered

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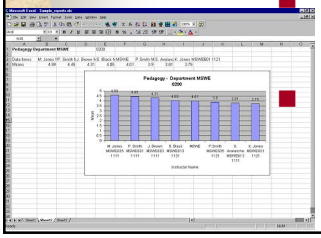
Online student evaluation system upgrade (2000)

- Automated an existing process
- Overcame a file format incompatibility problem
  - Needed arduous manual work
- Provided results in days instead of weeks
- Preserved confidentiality of information



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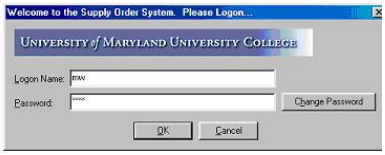
Supply order system (2000)

- Allows the Graduate School departments to access and order the supplies they need
- Allowed the departments to review their supplies every month
  - via a web based inventory sheet
- Tracked supplies to determine an optimum on-hand supply list
- automatically ordered supplies based on their liquidation rates



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WebForum (1999 and 2000)

- A Web based Conference that operates continuously
- Submissions are posted as and when received
- Rated by audience
- Postings can be text, graphics or Real media streaming format
- Asynchronous discussion threads handle questions and answers.

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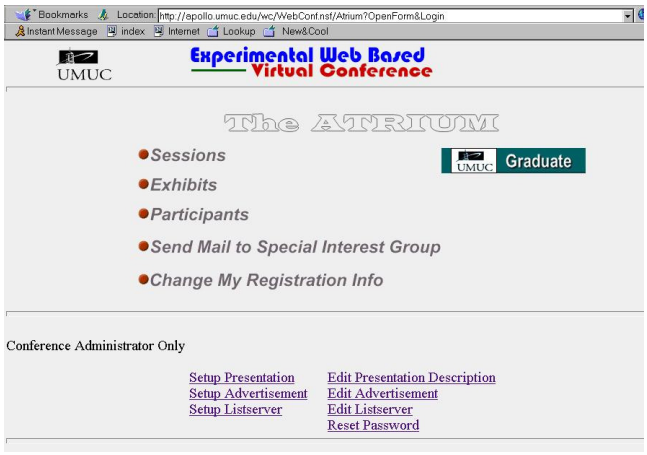
WebForum 1999



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WebForum 2000

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Webphone (2000)

- Allowed a specific named group of people to talk to each other using voice via the Internet in synchronous mode.
- An enhanced synchronous chat mode for the asynchronous on-line classes
- Modified COTS application

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Students produced

- Working software and online help information
- Manuals and documentation
  - Installation
  - Programmers
- Process-products
  - PMP, Requirements, designs, test plans and reports, management review packages
- Milestone review packages
  - OCR, SRR, PDR, CDR, DRR, **CAT**
  - Online presentations (2000)

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Can you get projects like these completed in 14 weeks?

MSWE 617 Spring 1999, http://polaris.umuc.edu/~jkasser/classes/m6179902/mswe617.htm, last accessed October 23, 2002.

MSWE 617 Spring 2000, http://polaris.umuc.edu/~jkasser/classes/m6170002/mswe617.htm, last accessed October 23, 2002.

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Summary

- The SLC consists of multi-phased, time-ordered, parallel-processing tasks
- The Cataract methodology can produce systems that converge with the needs of the customer
  - with fewer cost and schedule escalations and project failures
  - provided appropriate knowledge management and configuration tools are used

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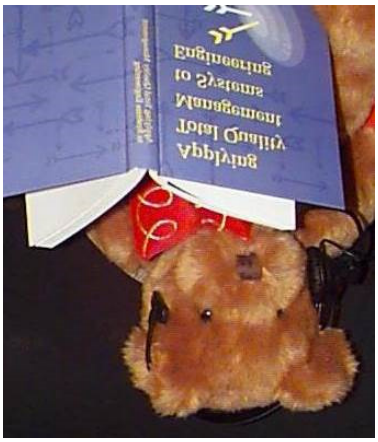
Discussion, Questions or Comments?

- QSE
- FREDIE
- CRIP Charts
- MSWE projects



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Quality System Elements

01. **Unique identification number.**
02. **Requirement (F + Qc)**
03. **Traceability to source(s) and implementation**
04. **Priority**
05. **Estimated cost**
06. **The level of confidence in the cost estimate**
07. **Rationale for requirement**
08. **Planned verification methodology(s)**
09. **Risk**
10. **Keywords**
11. **Production parameters**
12. **Testing parameters**
13. **Traceability sideways to Document duplicate links**
14. **Access control parameters**