Chapter 3

The Web Engineering (WebE) Process

Classic Software Engineering Process

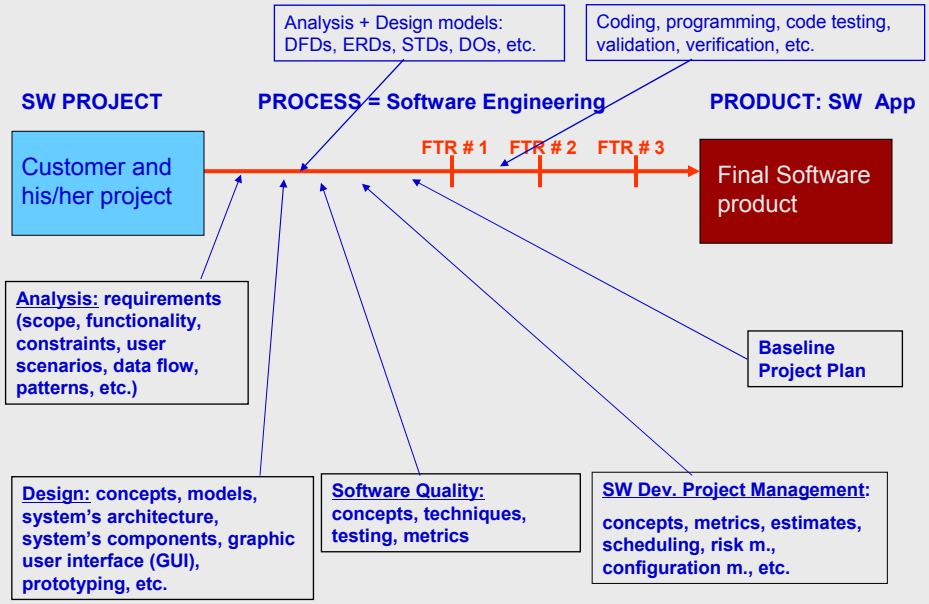
The IEEE definition:

Software Engineering is the application of a
- systematic,
- disciplined,
- quantifiable approach

to the
- development,
- operation, and
- maintenance

of software; that is, the application of engineering to software.

SW Development Project –> SW Eng Process –> SW Product



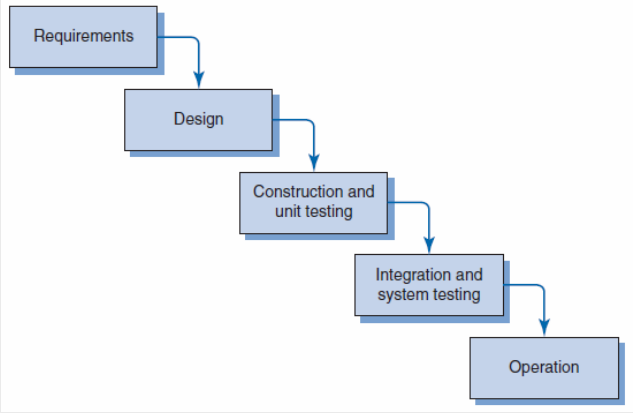
The Web Engineering Process

The WebE process must be 1) agile and adaptable

… but it must also be *2) incremental*

Classic Models of Software Engineering

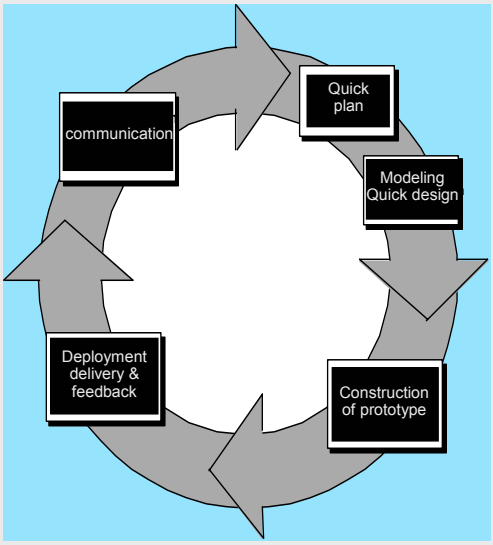
Waterfall Model



Waterfall Model

- **Strengths**
  - Is well understood by most practitioners
  - Easier to manage than the new agile methods
  - When working on large complex applications
  - When teams are distributed geographically
  - When using a less experienced IT resources
- **Weaknesses**
  - Does not accommodate a change to requirements very well
  - All Requirements must be known and defined in the beginning
  - Does not allow a repeat of a phase (iterate)
  - Limited adaptability to different project types
  - Encourages communications gap between users and IT

Prototyping Model



Source: Software Engineering, 7th Ed., by Roger Pressman

Types of Prototyping Model

- Throwaway prototyping – (also called *close Ended Prototyping, or Rapid Prototyping*) refers to the creation of a model that will eventually be discarded rather than becoming part of the final delivered software.
- Evolutionary Prototyping (also known as *Breadboard Prototyping*) is quite different from Throwaway Prototyping. The main goal when using Evolutionary Prototyping is to build a very robust prototype in a structured manner and constantly refine it.
- Incremental prototyping – In this case final product is built as separate prototypes. At the end the separate prototypes are merged in an overall design.
- Extreme prototyping -- Extreme Prototyping as a development process is used for developing especially web applications. Basically, it breaks down web development into three phases, each one based on the preceding one. 1) The first phase is a static prototype that consists mainly of HTML pages. 2) In the second phase, the screens are programmed and fully functional using a simulated services layer. 3) In the third phase the services are implemented. The process is called Extreme Prototyping to draw attention to the second phase of the process, where a fully-functional UI is developed with very little regard to the actual services to be used.

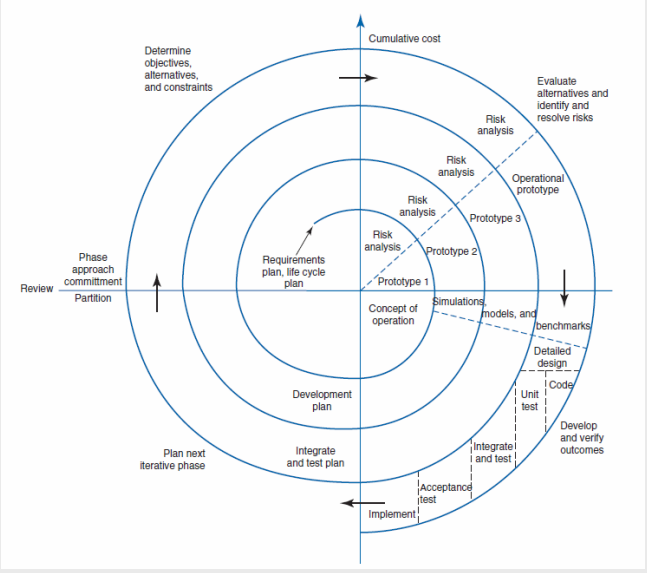
Prototyping Model

- Focuses on gathering correct and consistent requirements and is the approach of building a system incrementally through a series of gradual refinements or prototypes
- Requirements are discovered throughout the process and the system is repeatedly refined based on those discoveries
- Allows developers to learn from each prototype and apply those lessons to future versions
- The prototyping approach is an excellent choice for research and development projects, quickly building mockups of system components for user review allows for timely feedback that can be incorporated in the next design or prototype

Evolutionary Prototyping

- **Strengths**
  - Visibility – customers see steady progress
  - Useful when requirements are changing rapidly or no one fully understands the requirements
- **Weaknesses**
  - It is impossible to know at the beginning of the project how long it will take
  - There is no way to know the number of iterations/phases that will be required
  - Difficult to build an accurate cost estimate

Spiral Model



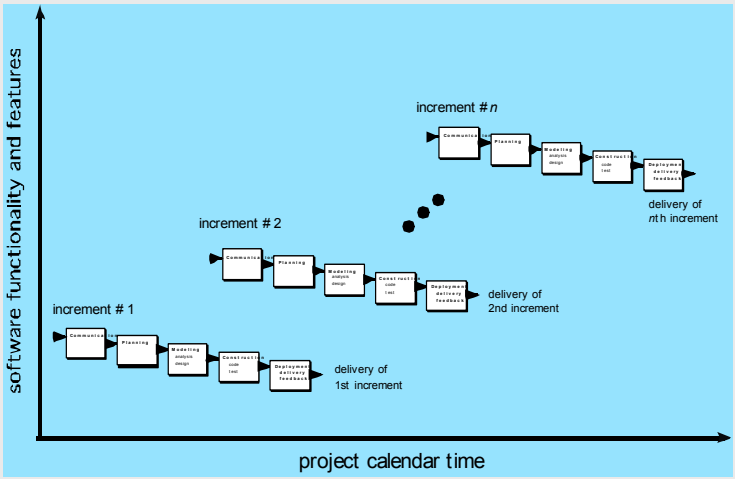
Spiral Model

- Similar to the classic waterfall model with the addition of risk analysis and iterations
- Emphasizes the need to go back and reiterate earlier stages a number of times as the project progresses
- It's actually a series of short waterfall cycles, each producing an early prototype representing a part of the entire project

Spiral Model

- **Strengths**
  - Good for large complex projects
  - Accommodates change well
  - Can react to risks very quickly
  - Software produced early in the life of the project
  - Increased user visibility
- **Weaknesses**
  - Can be a costly model to use
  - Risk analysis requires highly specific expertise
  - Project's success highly dependent on risk analysis
  - Doesn't work well for small projects

Incremental Model



The 1st increment = a *core product*.

Following increments are aimed to better meet customer requirements and deliver additional functionality

Source: Software Engineering, 7th Ed., by Roger Pressman

The Incremental Model: Real World Example

- By September 1991, **Linux version 0.01** was released. It had 10,239 lines of code.
- In October 1991, **Linux version 0.02** was released.
- In December 1991, **Linux 0.11** was released. This version was the first to be self-hosted - Linux 0.11 could be compiled by a computer running **Linux 0.11.**
- When he released **version 0.12** in February 1992, Torvalds adopted the GNU General Public License (GPL) over his previous self-drafted license, which had not permitted commercial redistribution.
- In March 1992, **Linux version 0.95** was the first to be capable of running X. This large version number jump (from 0.1x to 0.9x) was due to a feeling that a version 1.0 with no major missing pieces was imminent. However, this proved to be somewhat overoptimistic, and **from 1993 to early 1994, 15 development versions of version 0.99 appeared**.
- On 14 March 1994, **Linux 1.0.0** was released, with 176,250 lines of code.
- In March 1995, **Linux 1.2.0** was released (310,950 lines of code).
- **Version 2** of Linux, released on 9 June 1996, was followed by additional major versions under the version 2 header, including the following ones:
- 25 January 1999 - **Linux 2.2.0** was released (1,800,847 lines of code).
- 18 December 1999 - IBM mainframe patches for 2.2.13 were published, allowing Linux to be used on enterprise-class machines.
- 4 January 2001 - **Linux 2.4.0** was released (3,377,902 lines of code).
- 17 December 2003 - **Linux 2.6.0** was released (5,929,913 lines of code).
- 9 June 2009 - **Linux 2.6.30** was released (11,637,173 lines of code).

In July 2009 Microsoft contributed 20,000 lines of code to the Linux kernel. The contribution consisted of Hyper-V drivers, which improve the performance of virtual Linux guest systems in a Windows hosted environment. Microsoft licensed its Linux Hyper-V drivers under the GPL.

Incremental Model

- Repeating a process phase until ultimately meeting the project requirements (iterating the phases) and developing and delivering a system in stages (increments)
- The system grows by adding new and enhanced functionality with each build cycle
- Each cycle tackles a relatively small set of requirements and proceeds until the entire scope of the project is completed
- Similar to the spiral model

Incremental Model

- **Strengths**
  - Generates working software quickly and early
  - Flexibility
  - Ease of testing
  - Ease of risk management
- **Weaknesses**
  - Not easy to manage
  - Must be able to estimate well to plan iterations
  - Hard to determine cost and time estimates early in the process

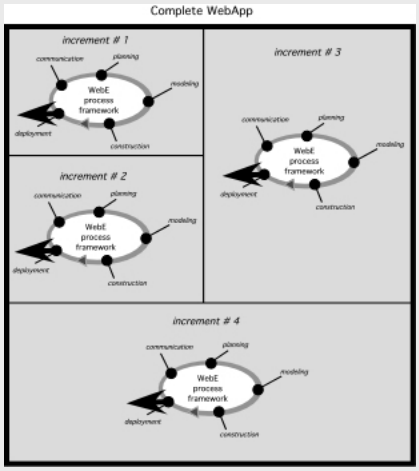
The Web Engineering Process

- **The WebE process must be agile and adaptable, but it must also be *incremental***
- **Why incremental?**
  - Requirements evolve over project time (duration) ☹
  - Changes will occur frequently (and always at inconvenient times for engineers and developers ☹
  - Time lines are short … and very short … ☹
- **Incremental delivery allows you to manage this change!**

Incremental Model in Web Engineering

(… is very close to an Incremental Prototyping Model of Software Engineering ! Sorry for a terminological confuse ☹)

Incremental Delivery



Repeat the development cycle for each increment!

Questions

- **Should we throwaway a previous increment ?**
- **Will we use a previous increment and refine it?**
- **Should we use primitive tools (like HTML) for fist increments and sophisticated tools (like Dreamweaver) for following increments?**
- **…**

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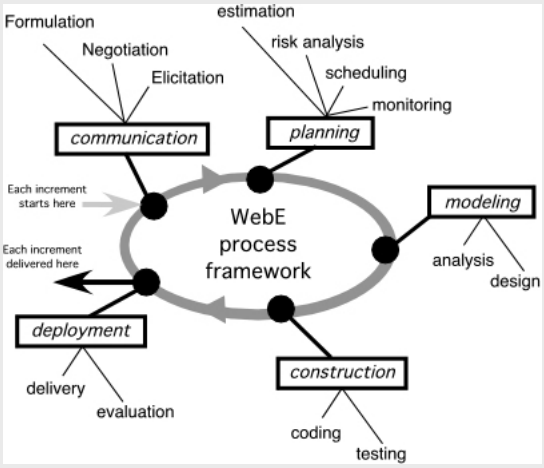
Web Engineering Process: Activities & Actions



SafeHomeAssured.Com Example: Conducting Framework Activities-I

- **The first iteration**
  - define business context
  - establish overall requirements
  - create a set of usage scenarios
  - negotiate conflicting needs among stakeholders, and
  - from this information derive the set of WebApp increments that is to be delivered.
- **Develop a broad outline of all components, recognizing that it will change**

SafeHomeAssured.Com Example: Conducting Framework Activities-II

- **The second iteration**
  - You've learned that the first increment is an informational WebApp and it must be delivered in one week!
  - You meet with stakeholders and later review your notes:
    - Logo and graphics—need aesthetic design.
    - One- or two-paragraph introduction.
      - CPI mission statement (file exists)
      - A word to visitors (someone will write this tomorrow)
    - Basic navigation bar will look like …
      - About the company
      - Our offerings
        - Home security products (hierarchical at next level)
        - Monitoring services (a list)
      - Our Technology (the new sensor)
      - Contact us
    - Other issues:
    - Informational content will change over time.
      - This "home page" will be the navigation starting point for content and functions required for subsequent increments.

SafeHomeAssured.Com Example: Conducting Framework Activities-III

- **The second iteration**
  - You spend a few minutes developing a plan
    - Day 1: Create a prototype layout (a model) of the WebApp.
    - Collect and review all existing CPI content and graphics.
    - Get stakeholder feedback on prototype, if possible.
    - Day 2: Using the prototype as a guide, begin construction of the increment.
    - Build navigation bar.
    - Lay out content areas.
    - Integrate graphics, links, etc.
    - Test all links for validity.
    - Review all content for completeness and correctness.
    - Day 3: FTP all files to (an existing) domain.
    - Perform navigation tests.
    - Deployment: Inform selected stakeholders that the increment is available.
    - Day 4: Poll stakeholders for feedback.
    - Make modifications based on stakeholder feedback.

SafeHomeAssured.Com Example: Conducting Framework Activities-IV

- **The next iteration**
  - You've deployed the informational WebApp
- **the communication activity during this second iteration will identify the requirements (including content and functionality)**
  - assume that the second increment delivers the capability to select and download product specifications and related information
- **the process flow is restarted at the beginning, performing the communication activity for this increment.**
- **The tasks you select to populate each framework activity for the increment may differ from the tasks performed for the preceding increment, but the overall process flow remains the same**

Tools for Quick Prototypes and Increments: Desktop Applications (examples)

- Apple Xcode
- C++Builder
- Clarion is a data-centric Advanced Rapid Application Development tool
- Code::Blocks
- Delphi
- Delphi for PHP
- Gambas Basic, Open source, Linux
- Gupta Team Developer / SQLWindows
- Habanero
- Microsoft Visual Basic
- Lazarus Pascal, Open Source, Multi-platform
- Panther
- RADvolution Designer
- Runtime Revolution
- REAL software REALbasic
- Softwell Maker is a desktop IDE with a cross-plataform deployment component allowing publish application into almost any Java enable system.
- Thoroughbred OPENworkshop is a RAD for Windows, UNIX, Linux, and OpenVMS
- The Virtual Enterprise is an Interactive Voice Response (IVR) toolkit developed specifically for telephony and speech inside Microsoft Visual Studio.NET.
- wxDev-C++
- Microsoft Visual Foxpro
- WinDev
- XVT
- MX-Frame - Business Application Framework
- GNAVI

Tools for Quick Prototypes and Increments: Databases (examples)

- Base One Foundation Component Library (BFC) is a RAD framework for building .NET applications using SQL Server, Oracle, DB2, Sybase, and MySQLdatabases.
- Clarion is a data-centric Advanced Rapid Application Development (ARAD) tool featuring roundtrip code generation. uniPaaS (by Magic Software) is a database independent Rapid Application Tool for building traditional GUI applications as well as scaling enterprise-level websites. IBM Rational Business Developer Extension supports database application development for IBM DB2, IBM Informix, Oracle database, Microsoft SQL Server and other JDBC compliant relational databases.
- IBM Rational Application Developer supports database application development for IBM DB2, IBM Informix, Oracle database, Microsoft SQL Server and other JDBC compliant relational databases
- IBM Lotus Notes is a RAD environment for collaboration and document management tasks
- is code generator that builds database-driven web Web 2.0 applications for .NET. It generates application Web pages ASPX, user interface code and data access logic (C#, Visual Basic .NET; and SQL queries) without hand-coding.
- FileMaker is a cross-platform database application from FileMaker Inc. (a subsidiary of Apple Inc.)
- Sybase PowerBuilder is data-driven development tool for creating client/server, distributed, Web and Smart Clients applications for JEE, Win32, and .NET platforms.
- is an open source database-driven RAD development environment for building client (desktop) based applications.
- Kexi is an open source database-driven RAD development environment for building desktop applications. It is considered an alternative to Open Office Base in the Open Source environment and provides similar features to commercially available RAD development environments such as FileMaker, Alpha Five and Microsoft Access.
- Oracle Forms
- Oracle Application Express (Oracle APEX) is software development environment based on the Oracle database. It allows a very fast development cycle to be achieved to create web based applications.
- Panther (and its open source version POSSL) is a cross-platform (Windows, Unix, Linux; TUI, GUI, Web), cross-database RAD toolset for development of C/S and n-tier database oriented applications.
- NConstruct is Windows and Web rapid enterprise application development tool and environment for .NET framework. It supports Oracle database, Microsoft SQL Server databases and Microsoft Access.
- EASYProcess is a .NET based RAD for the creation of web portal interfaces, work flows, data integration, reporting and web services largely focused on the JD Edwards community.
- Softwell Maker is a ultra RAP data-centric IDE with a cross-platform deployment component allowing publish application into almost any Java enable system.
- WinDev

Tools for Quick Prototypes and Increments: Web-Based Tools (examples)

- Active Agenda's code generator is a RAD development framework using XML specification files and the PHP development language.
- Alpha Five is a commercial RAD development environment for both client and web-server based database driven applications. This tool is typically classified with commercial packages such as Microsoft Access and FileMaker.
- Axiom Stack is an open source web application framework designed to foster rapid development through the use of ECMAscript (JavaScript) and Java. Tools such as the Axiom CMS and Inspector are written to aid in application development.
- BFC is a RAD framework for both client and server-side development in the .NET environment.
- CakePHP is a RAD development framework using the PHP development language.
- is a visual RAD development environment for web-based database driven application development. places emphasis on code generation technology to provide ASP.NET, PHP, JSP, Servlets, ColdFusion and Perl language support.
- Zend Framework is an open source, object-oriented web application framework licensed under the New BSD License.
- Django is an open source web application framework, written in Python, which loosely follows the model-view-controller design pattern
- IBM Rational Business Developer Extension is a cross-platform, Rapid Application Development IDE for creating enterprise and web applications and services for Windows, Linux, Unix (Solaris, HPUX, AIX), System z and System i
- NConstruct is Windows and Web rapid enterprise application development tool and environment for .NET framework.
- nuBuilder is an open source browser based database development tool which stores all forms, reports, data and any custom code in MySQL and displays the content dynamically.
- Oracle Application Development Framework uses Oracle's JDeveloper a FREE IDE that supports ADF's J2EE based framework.
- Panther (and its open source version POSSL) is a cross-platform (Windows, Unix, Linux; TUI, GUI, Web), cross-database RAD toolset for development of C/S and n-tier database oriented applications.
- Pylons is an open source web application framework, written in Python, which makes extensive use of the Web Server Gateway Interface (WSGI) standard to promote re-usability and to separate functionality into distinct modules.
- Radicore is a RAD development framework using the PHP development language. It is for building administrative web applicatons, not web sites, and includes a Role Based Access Control (RBAC) system, Audit Logging system (without database triggers), Data Dictionary and Workflow system.
- Thoroughbred T-WEB is a Web RAD tool
- Web2py is a RAD framework for web-based database driven applications with key features including in-browser coding support, admin/design interface, DAL (database abstraction layer), and translation support.
- WebDev
- Wavemaker Visual Ajax Studio is an open-source, browser-based IDE based on Dojo, Spring and Hibernate.
- Wolf Frameworks is a 100% AJAX, XML & .NET based Platform for designing and delivering cross platform web applications using a browser.
- Visual WebGui Visual WebGui (VWG) is an open-source rapid application development (RAD) framework for AJAX & Silverlight GUIs. The platform presents a new approach to applying desktop usability to the web by viewing it as an extension to a desktop rather than web
- cakeApp an online rapid development tool with WYSIWYG SQL editor and framework based on CakePHP.
- Wavemaker Visual Ajax Studio is an open-source, browser-based IDE based on Dojo, Spring and Hibernate.
- is a web based development and design tool for designing forms and pages for mobile and hand-held devices as well as delivering cross platform web applications using a standard internet browser.

Tools for Quick Prototypes and Increments: Cross-Platform Tools (examples)

- Boa constructor is a cross-platform, open-source, Python based RAD IDE
- Code::Blocks is a cross-platform C/C++ RAD IDE using wxWidgets; the latest developmental builds have a built-in form designer wxSmith, so it's similar to Borland C++ Builder and Microsoft Visual C++/MFC now.
- HyperNext is a freeware cross-platform software development system for Macintosh OS X & OS 9, and Microsoft Windows XP & Vista. It has many similarities with HyperCard and can compile to both stand alone applications and stacks for the cross-platform HyperNext Player.
- IBM Rational Business Developer Extension is a cross-platform, Rapid Application Development IDE for creating enterprise and web applications and services for Windows, Linux, Unix (Solaris, HPUX, AIX), System z and System i
- IBM Rational Application Developer is a cross-platform, Rapid Application Development IDE for creating enterprise and web applications and services for Windows, Linux and Unix (Solaris, HPUX, AIX)
- LANSA is a development environment for generating applications on multiple computer systems. The main feature of the LANSA environment is the RDML language. It is classified as a 4GL (4th generation computing language). It runs on many systems including MS Windows, Unix, and Linux. In its first release in 1987, the RDML language was known as lambda
- Lazarus is a cross-platform IDE similar to Borland Delphi.
- m-Power is a Software Development tool which automates application development and rapidly creates enterprise-class Web applications over any database or platform.
- NetBeans is a cross-platform, RAD IDE for creating visual desktop, mobile, web, and SOA applications for Linux, Windows and Mac OS X. The IDE officially supports Java, Ruby, PHP , JavaScript and C/C++ programming languages.
- Omnis Studio is a cross-platform, Rapid Application Development tool or IDE for creating enterprise and web applications for Windows, Linux, Solaris, and Mac OS X.
- (OpenERP) is a RAD framework in python.
- OpenROAD is a cross-platform IDE for Linux/Unix, Windows with embedded SQL support
- Panther (and its open source version POSSL) is a cross-platform (Windows, Unix, Linux; TUI, GUI, Web), cross-database RAD toolset for development of C/S and n-tier database oriented applications.
- REALbasic is a cross-platform IDE for creating desktop applications for Windows, Linux and Mac OS X.
- Runtime Revolution is a cross-platform RAD which creates desktop applications for Mac Classic, Mac OS X, Windows 98/Me/XP/Vista, and various flavors of Linux.
- Web Dynpro is SAP's RAD to create web applications connected to function modules in mySAP ERP.
- RadRails is a cross-platform IDE for creating Ruby on Rails web applications.
- Servoy Servoy is a cross-platform application development and deployment environment. Servoy consists of a GUI designer, is event-driven and runs scripts through JavaScript. Servoy allows applications to be deployed to both a native Smart client / Rich client and to a pure HTML Web client from the same codebase and user interface
- WideStudio is an open source integrated development environment for desktop applications purely
- XVT is a cross-platform, Rapid Application Development IDE for creating enterprise and desktop applications in C/C++ on Windows, Linux, Unix (Solaris, HPUX, AIX), and Mac
- CA Plex, a software development tool that combines the techniques of model-based development, patterns and code generation to accelerate the delivery and maintenance of multi-platform, distributed business applications

Web Engineering: Umbrella Activities

- Background activities which occur in parallel with the main development activities.
- Equally important to the success of a project
- Many umbrella activities can be defined. But only four are crucial for a successful Web engineering project:

1. Project management.	Tracks and monitors progress as an increment is engineered.
2. Quality assurance.	Defines and conducts those tasks that help ensure that each work product and the deployed increment exhibits quality.
3. Change management.	Manages the effects of change as each increment is engineered, integrating tools that assist in the management of all WebApp content.
4. Risk management.	Considers project and technical risks as an increment is engineered.