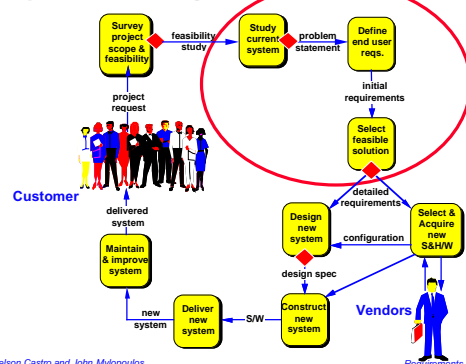


## VIII. Requirements Analysis

Functional and Non-Functional Requirements  
Customer-Driven vs Market-Driven vs User-Driven Projects  
The State of Practice



## Requirements Analysis



## What Are Requirements?

"...Requirements definition is a careful assessment of the needs that a system is to fulfill...must say *why* a system is needed, based on current and foreseen conditions, which may be internal operations or an external market...must say *what* system features will serve and satisfy this context...must also say *how* the system is to be constructed..."

[Ross77]

- Requirements represent a specification for the new system.
- Effectively a "contract" between client and developer
- We usually distinguish between
  - ✓ *Functional requirements*, which describe functions that the new system must support;
  - ✓ *Non-functional* (or, *quality*) *requirements*, which impose global constraints on the system;

## Functional Requirements

- Describe the processing required from the new system;
- Describe the inputs into the system from paper forms and documents, from interactions with people, such as email messages, and from other systems;
- Also describe the outputs that are expected from the system in the form of printed documents, screen displays and data transfers to other systems,
- Finally, they describe the data that must be held in, and managed by the system so that it can fulfill its required functions.

*Functional requirements describe the system with respect to its environment, NOT its internal workings!*

## Non-Functional Requirements

- Describe aspects of the system that are concerned with how well it supports the functional requirements (hence the name non-functional, or quality requirements).
- This description may include:
  - ✓ Performance criteria such as desired response times for updating data in the system or retrieving data from the system;
  - ✓ Reliability requirements, e.g., the system must crash on average once every 6 months;
  - ✓ Security considerations, e.g., access rights for different groups of users;
  - ✓ Standards the working systems should meet;
  - ✓ Usability requirements, such as: users will be able to use the system after 2 days of training;
  - ✓ ...more...

## Bill Gates on Non-Functional Requirements

'Products should emphasize security right out of the box'  
January 17, 2002 Posted: 8:54 AM EST (1354 GMT)

WASHINGTON (AP) -- Microsoft's chairman, Bill Gates, is steering his software empire onto a new strategic heading, putting security and privacy ahead of new capabilities in the company's products.

In an e-mail to employees obtained by the Associated Press, Gates refers to the new philosophy as "Trustworthy Computing" and says his highest priority is to ensure that computer users continued to venture safely across an increasingly Internet-connected world.

## Importance of Requirements Analysis

- Most errors (54%) are detected *after* coding and testing.
- Almost half of all errors in software (45%) are in requirements and design.
- Most errors made during requirements analysis are non-clerical (77%) and may arise because of incorrect facts, misunderstandings, inconsistencies, omissions and ambiguities.
- Errors in requirements which are detected after coding are generally very expensive to fix (up to 200 times the cost of error caught during requirements analysis.)
- Requirements errors can be detected, because inspection techniques have proven most effective for any software, and inspection techniques can be applied to requirements as well as design and code.

## Relative Cost of Repair

Stage	Relative Cost
■ Requirements	0.1 - 0.2
■ Preliminary Design	0.5
■ Coding	1.0
■ Unit Testing	2.0
■ Acceptance Test	5.0
■ Maintenance	20.0

## Customer- vs Market- vs User-Driven Projects

- **Customer-driven** projects involve customers who need a system that solves a particular problem; such projects are one-of projects
- **Market-driven** projects involve a developer who decides to develop a (generic) system that is to be sold in the market; often hard to determine for such projects what the customer really wants (...or, for that matter, who the customer really is)
- (Coming soon) **User-driven** projects involve a system which is used, for a fee, by a number of users; owner of the system has to evolve it according to user demands
- The concept of software is evolving from that of a **custom-built artifact**, to that of a **commodity** that you buy, and soon to that of a **resource** that you use.

## The State-of-Practice

[Lubars93] reports on a field study involving 10 organizations; study's conclusions are as follows:

- ✓ Customer-specific projects are usually given large monolithic statements of requirements, seldom in machine-readable form; despite their size, these are often sketchy, ill-defined; concept of "super-designer" used for interpretation, filling gaps.
- ✓ Market-specific projects often have smaller requirements, frequently produced in-house.
- ✓ Securing customer interaction always hard.
- ✓ Although many projects use document standards, few adopt any particular requirements method.
- ✓ Projects using object-oriented methods had trouble modularizing their requirements; some thought that structured analysis led to unintelligible specifications; no uniform treatment of performance or real-time issues.

## The State-of-Practice

- ✓ General purpose tools (e.g., hypercard), general-purpose or special purpose CASE tools, were used with some success.
- ✓ Many use organizational approaches for requirements validation.
- ✓ About 1/3 of the projects did some sort of prototyping.
- ✓ Organizational solutions preferred over technology -- instead of solving problems by buying hardware/software, organizations define procedures, assign people, set up committees etc.
- ✓ General-purpose technology preferred over CASE -- organizations rely more on word processors, hypertext, spreadsheet products, rather than CASE tools.
- ✓ Requirements activities are under-capitalized -- only 1/3 of the projects used some tools.
- ✓ Market-driven projects increasingly important -- as the software market matures, organizations are buying a generic, off-the-shelf solution, rather than design a one-of system.

## Additional Readings

- [Kotonya98] Kotonya, G. et al. *Requirements Engineering: Processes and Techniques*, John Wiley & Sons, 1998.
- [Lubars93] Lubars, M., Potts, C., Richter, C., "A Review of the State-of-Practice in Requirements Modelling", Proceedings, IEEE Symposium on Requirements Engineering, 1993.
- [Macaulay96] Macaulay, L., *Requirements Engineering*, Springer-Verlag, 1996.

