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INTRODUCTION TO SOFTWARE ENGINEERING

Software Engineering

Chapter 1

Goals

- Introduce Software Engineering and explain its importance for software development
- Answer main questions related to Software Engineering
- Introduce Software Process

Contents

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2. Software

- Characteristics
- Software Crisis
- Quality Software
- Industry Problems

3. Software Engineering

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- Software Process
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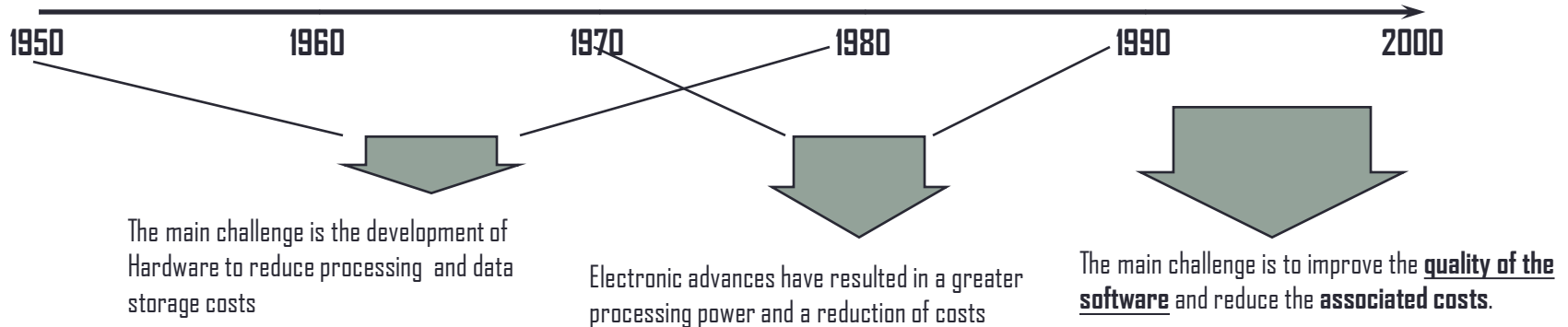
References

- Sommerville, I. Software Engineering. Addison-Wesley, 2008.
- Pressman, R., Software Engineering: A Practitioner's Approach. McGraw-Hill, 2005.
- Weitzenfeld, A., Object Oriented Software Engineering with UML, Java and Internet. Thomson, 2005

INTRODUCTION

Software makes a difference

In the latest decades software has overcome hardware as a critical factor for success

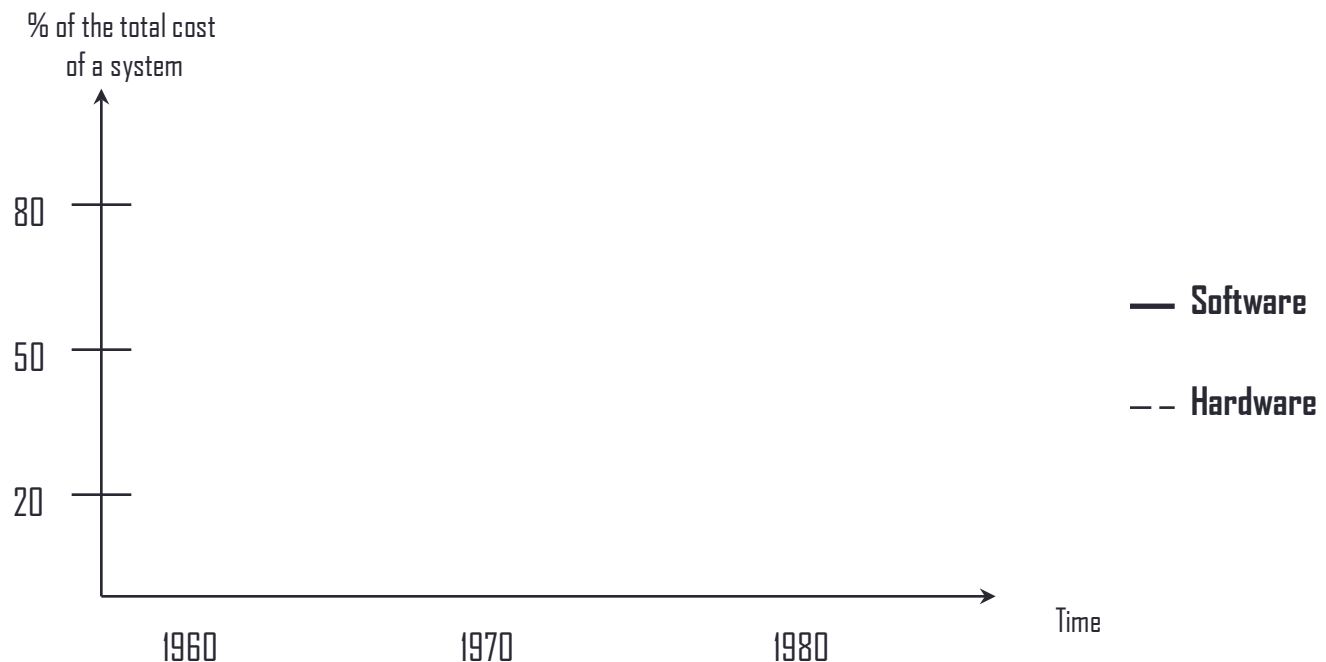


Software makes a difference

- In the last decade, as a result of the success of the Web as a platform and the use of mobile devices, the software industry has experienced a revolution
 - New languages
 - New HTML versions
 - New devices
 - New development methods!!

Software is more expensive...

- Evolution of the total cost of a system in terms of the percentage invested in software and in hardware



...and not just money!

- <http://www5.in.tum.de/persons/huckle/bugse.html>
- <http://www.pcmag.com/article2/0,1759,1636333,00.asp>
- <http://www.microsiervos.com/archivo/ordenadores/10-peores-bugs.html>
- <http://www.wired.com/software/coolapps/news/2005/11/69355?currentPage=all>
- <http://www.taringa.net/posts/info/3469982/Los-20-desastres-mas-famosos-de-la-historia-del-software.html>
- <http://catless.ncl.ac.uk/Risks>
- ARIANE 5: https://youtu.be/PK_yguLapgA

THE SOFTWARE

- ✓ Characteristics
- ✓ Software crisis
- ✓ Quality Software
- ✓ Industry Problems

What is software?

- Instructions that provide an expected function and behavior when executed
- Data structures that allow programs to adequately manipulate information
- Documents that describe the operation and use of programs

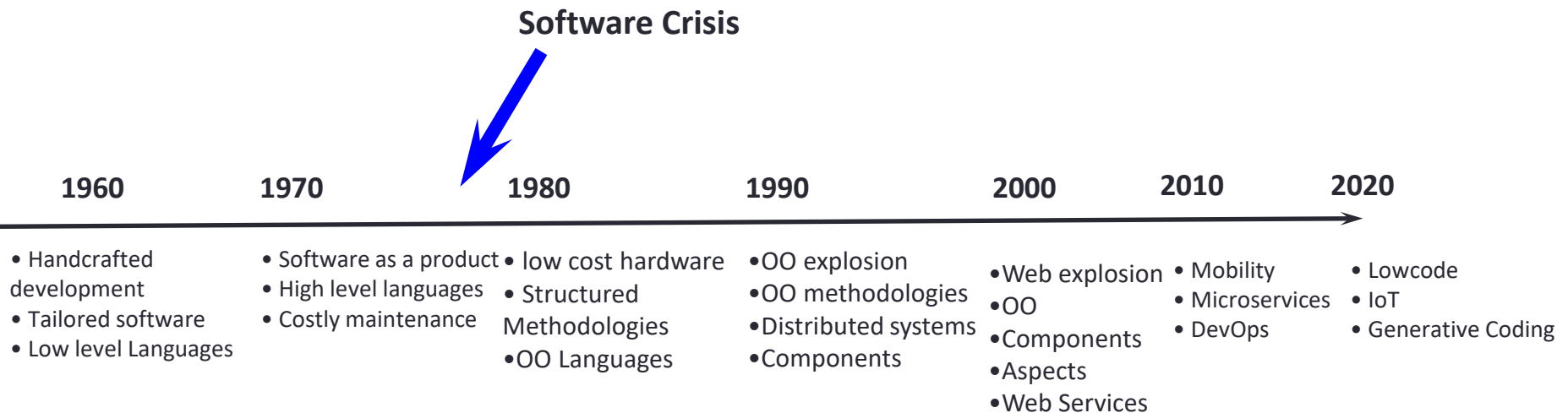
Characteristics of software

Software is a logical element:

- It is developed, not manufactured in the classical sense
- It doesn't break down, it deteriorates as a result of changes
- Most of it is tailored for specific purposes instead of being assembled from existing components

Software Evolution

- The **context** in which software is developed is strongly related to the development of computing systems



Software Crisis

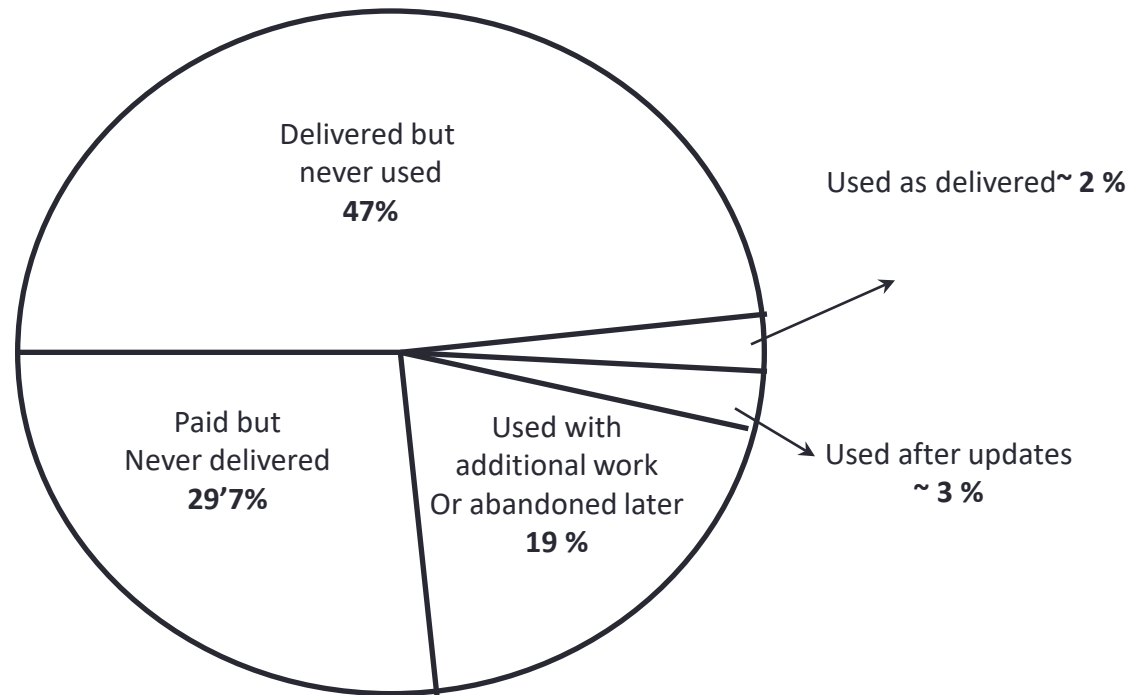
- Costs are higher than planned
- Delivery dates delays
- Bad Performance
- Impossible maintenance
- High cost of Updates
- Unreliable products

Low quality Software!

Software Crisis

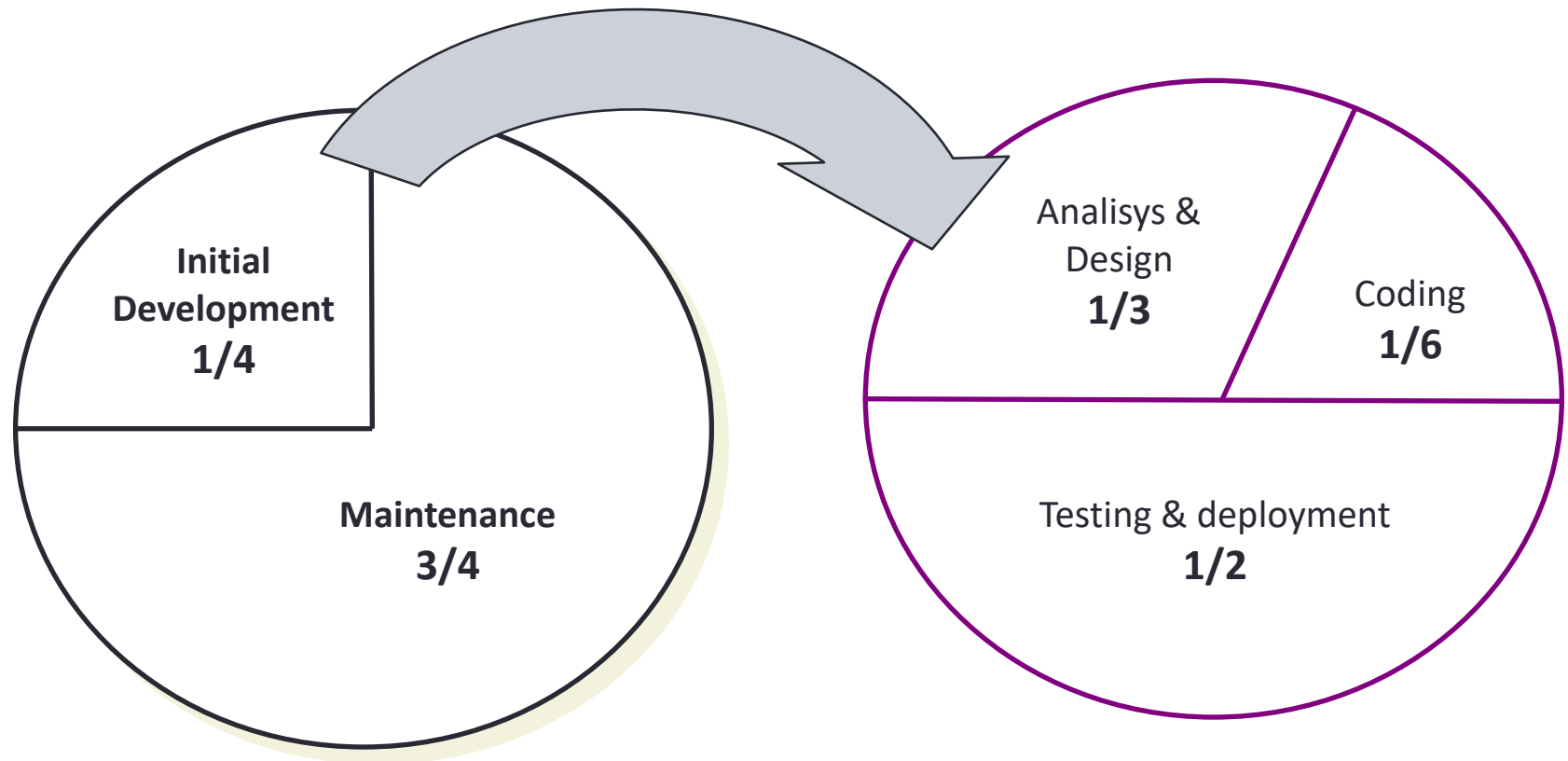
- **Investment** in Software development

- Year 1979 (Total: \$ 6.8 million)



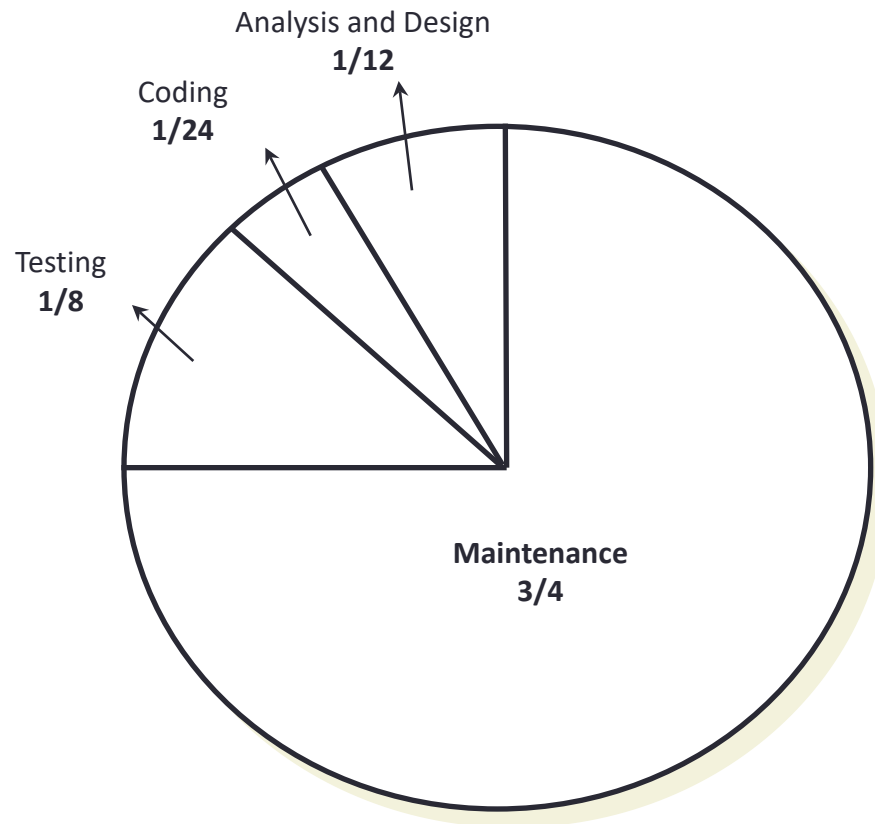
Software Crisis

- **Investment** in software development (by development phase):



Software Crisis

- Summary of **investment**:

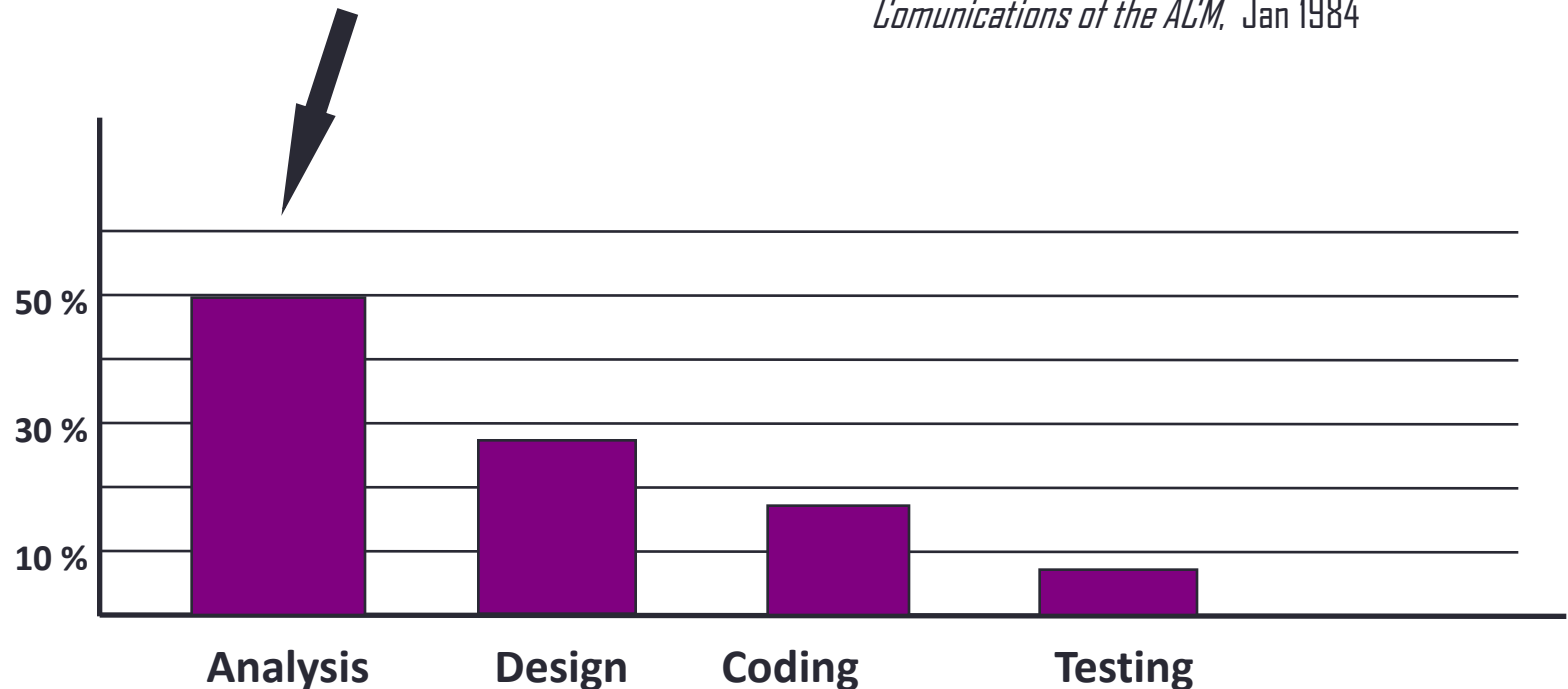


- Analysis & Design \Rightarrow 8 %
- Coding \Rightarrow 4 %
- Testing and Maintenance \Rightarrow 88 %

Software crisis

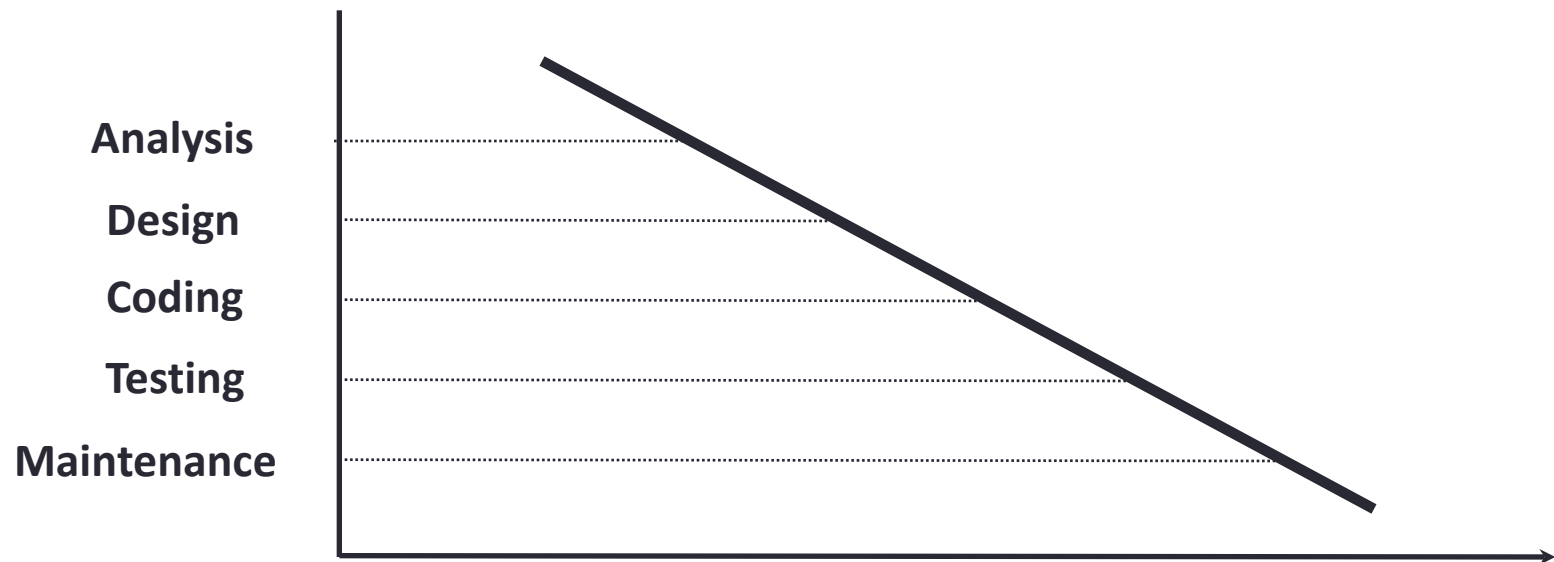
- **Errors** during software development (by development phase) :

Communications of the ACM, Jan 1984



Software Crisis

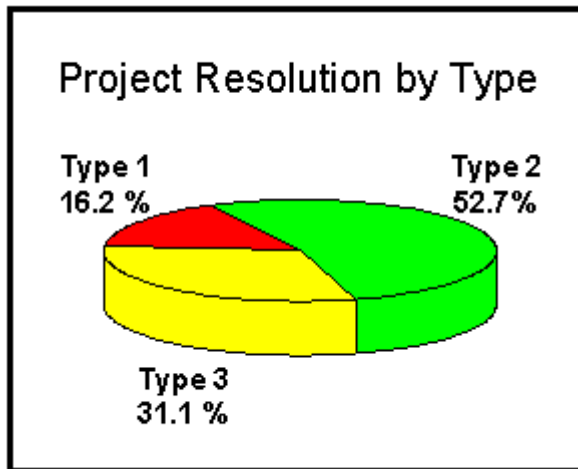
- **Cost of fixing errors:**



Software crisis

Investment in software development.

- Year 1994 (Total: \$ 250 Kmillions/year -- 175.000 projects)



- **Type 1 (Success).** The project is Ended on time and within budget with all initially planned features and functionalities.

- **Type 2 (Updates).** The project is Is ended late and at a higher cost It has less features and functionalities than were specified.

- **Type 3 (Cancelled).** The project is cancelled during its development.

Software crisis

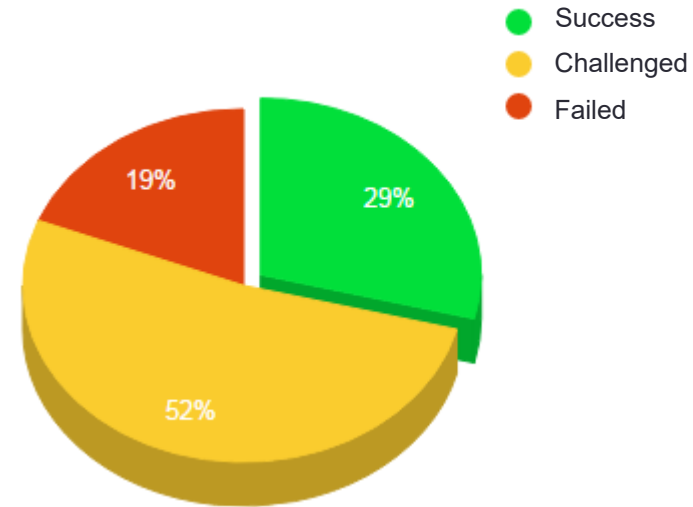
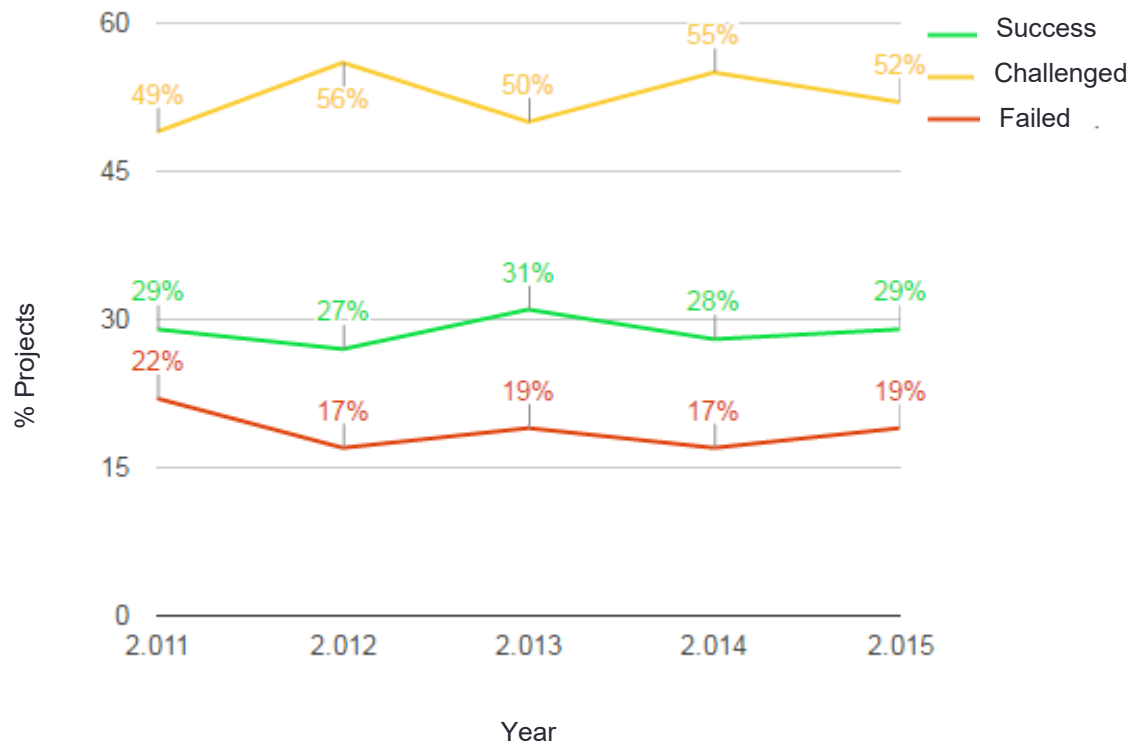
CHAOS Report...

RESOLUTION					
	2004	2006	2008	2010	2012
Successful	29%	35%	32%	37%	39%
Failed	18%	19%	24%	21%	18%
Challenged	53%	46%	44%	42%	43%

Project resolution results from CHAOS research for years 2004 to 2012.

Software crisis

CHAOS Report 2015

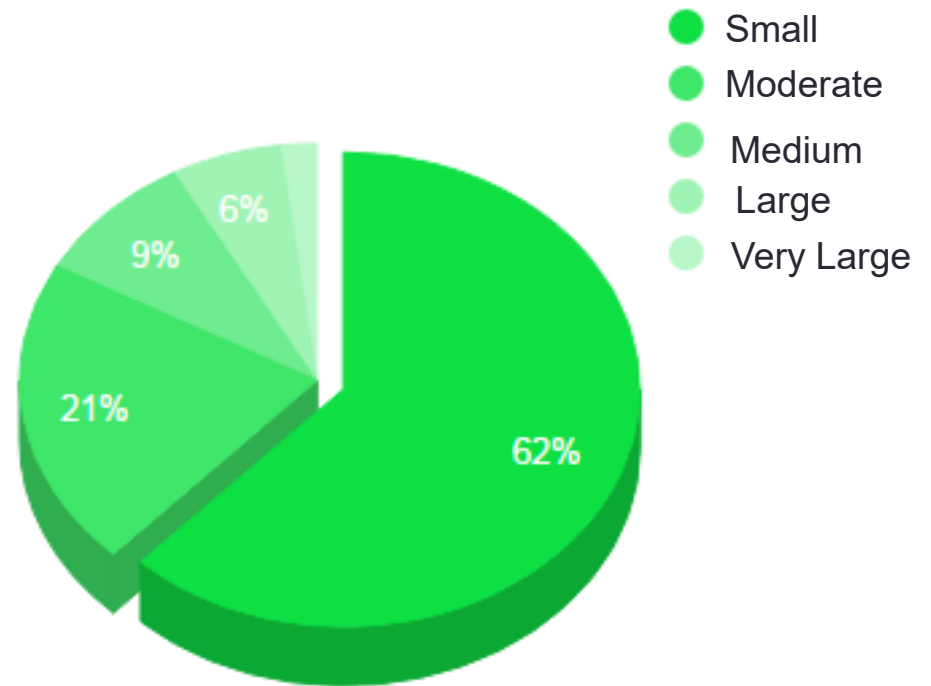


Software crisis

CHAOS Report 2015

Is the size of a software project relevant?

% over successful projects
2011-2015



Software crisis

CHAOS Report 2020

Year	Success	With Difficul	Failed
1994	16%	53%	31%
2020	31%	50%	19%

Quality software

- The end goal is to produce high quality software

What is high quality software?

Agreement with:

- Functional and non functional requirements
- The documented development standards
- The expected features exhibited by any software developed professionally

Quality factors

- The classification of the quality factors of software takes into account three important aspects of a software product
 1. Its operational features
 2. Its capability to support updates
 3. Its adaptability to new environments
- These must be measured direct or indirectly during the whole development process

Quality factors

Correctness Does it do what I want?

Reliability Is it reliable all the time?

Efficiency Will it run in the HW platform efficiently?

Integrity Is it safe?

Usability Is it designed to be used?

Operational
features

Maintainability May it be corrected?

Flexibility May it be easily changed?

Testability May it be verified?

Supporting
Updates

Reusability Is the software reusable?

Portability May it be used in another HW or OS?

Interoperability May it interact with another system?

Adaptability to
New
environments

Software Industry Problems

- Products are low quality
- High maintenance and development costs
- Delivery Delays

Reasons:

- ✓ *Little investment and effort in the analysis and specification phases*
- ✓ *Use of informal and inadequate models*
- ✓ *Non physical nature of programming*
- ✓ *Poor theoretical foundations*
- ✓ *Products already in the market make it difficult innovation*
- ✓ *High levels of hand crafting*
- ✓ *Groupwork*
- ✓ *Communication with users*
- ✓ *Project management by non computing engineers*

Solutions

- Education:
 - Formal methods (executable formal languages: logic + algebra)
 - New development methods and new lifecycles
- Difusion of technological advancements
 - New programming paradigms
 - Architectures, protocols, computation models
- Tools investment
 - Modern development environments
 - Documentation generation engines

SOFTWARE ENGINEERING

- ✓ Definitions
- ✓ The Software Development Process

Definitions

- B. Boehm:
 - “SE is the practical application of scientific knowledge in the design and construction of computer programs and the associated documentation required to develop, operate, and maintain them
- R. Pressman:
 - “SE is a discipline that integrates methods, tools and procedures for the development of Software”.
- A. Davis:
 - “SE is the application of scientific principles for: (1) the transformation of a problem into a SW solution and (2) its maintenance during all its life”.
- I. Sommerville:
 - “SE is an engineering approach covering all aspects of software production”

A little bit of history

- <http://www.cs.st-andrews.ac.uk/~ifs/Books/SE9/Web/History/>

Summarizing...

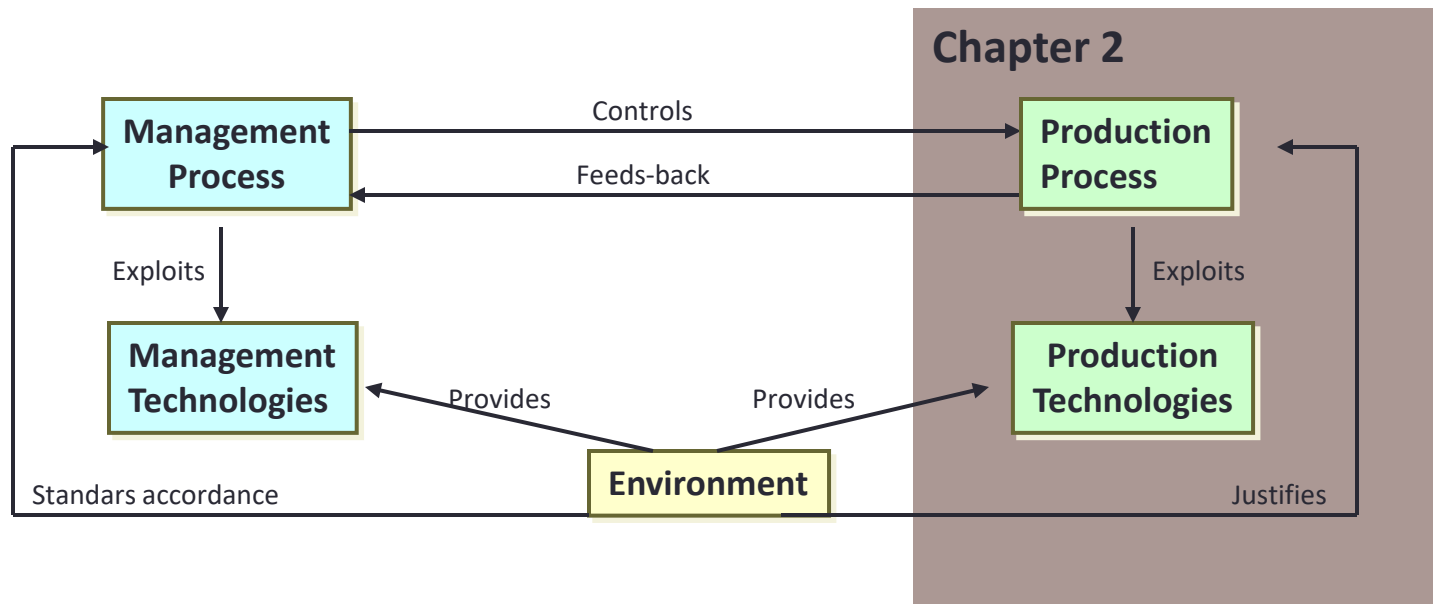
- SE is more than just coding
- The SE process starts well before writing lines of code and it continues after the first version of the product has been completed
- Key tasks are planning and rigorous control of software projects

The importance of the process

- The new challenges to be faced when developing software require fast and effective answers to changing requirements.
- The specification of a development process and the use of tools for its execution and monitoring are mandatory

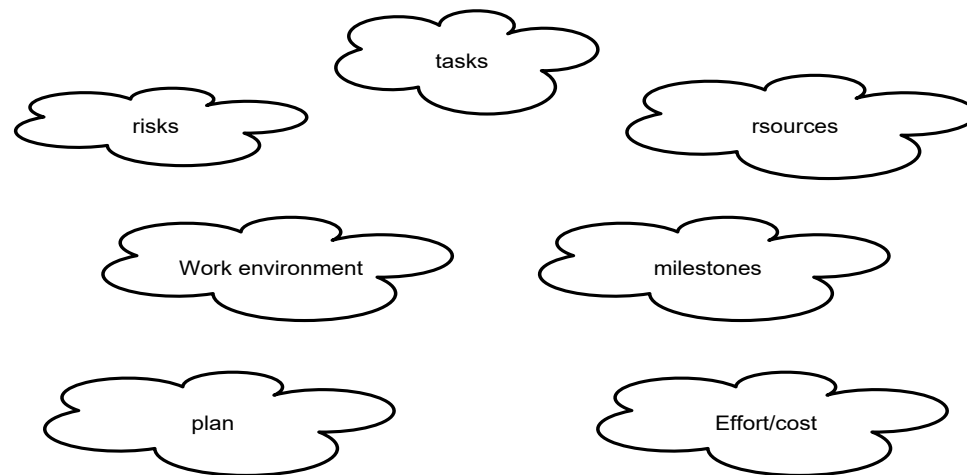
The Software process

- It is a framework for the development of software



Software projects management

- The management of a software project is the first level of a software development process and it covers all the development process



Software engineering vs Engineering

• Similarities

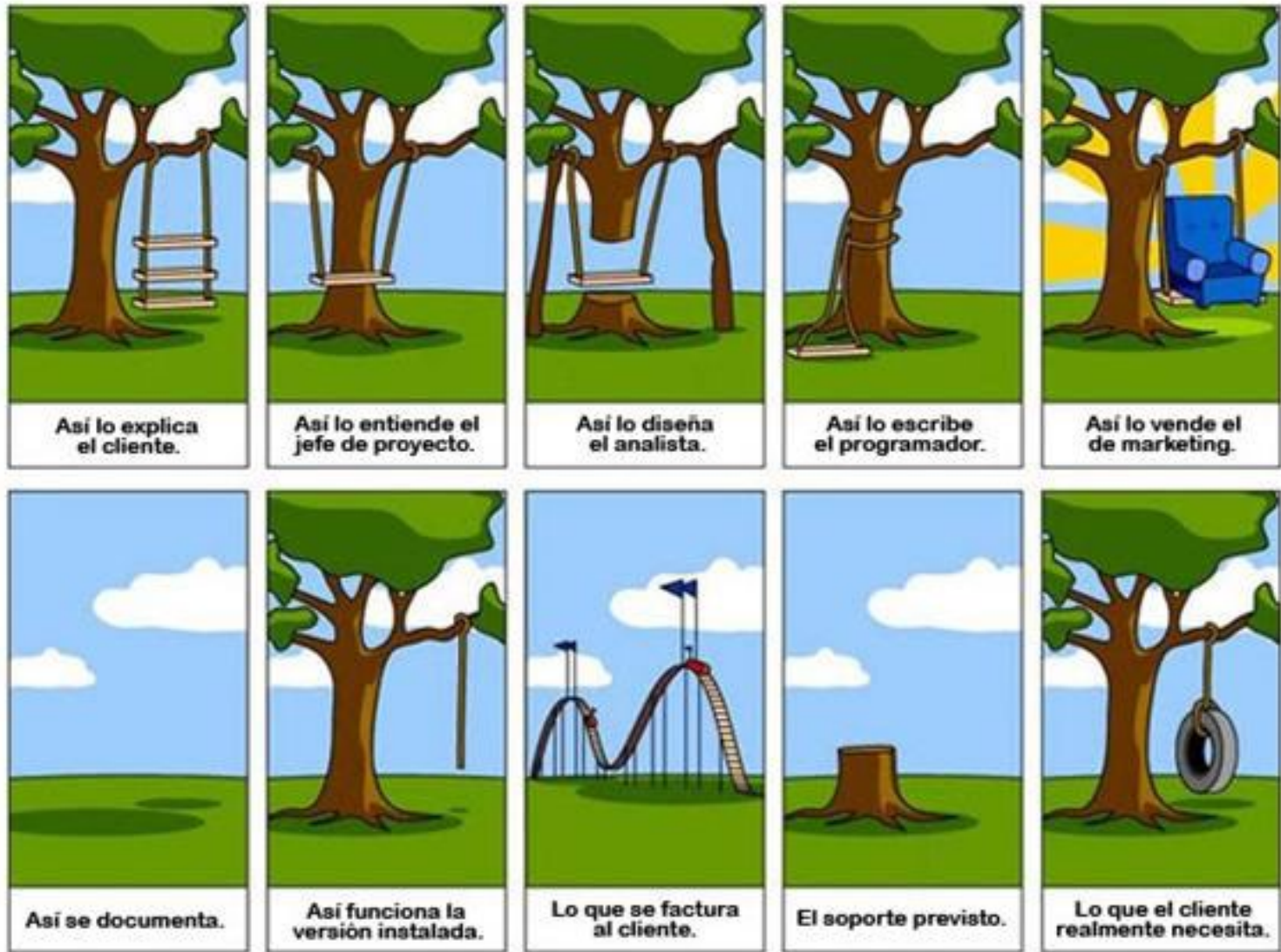
- Activities to be done are not specific of software projects
- Many common management techniques
- Many similar problems (time, resources, changing specifications...)

• Differences

- The product (software) is not tangible and flexible
- The software process is not standard. Several alternatives exist
- Many times software projects are “unique”

Software projects management

- Activities involved:
 - Writing proposal
 - Project planning
 - Cost estimation
 - Selection and evaluation of human resources
 - Project control
 - Writing and presenting reports



<http://histinf.blogs.upv.es/files/2011/01/vi%C3%B1eta.jpg>