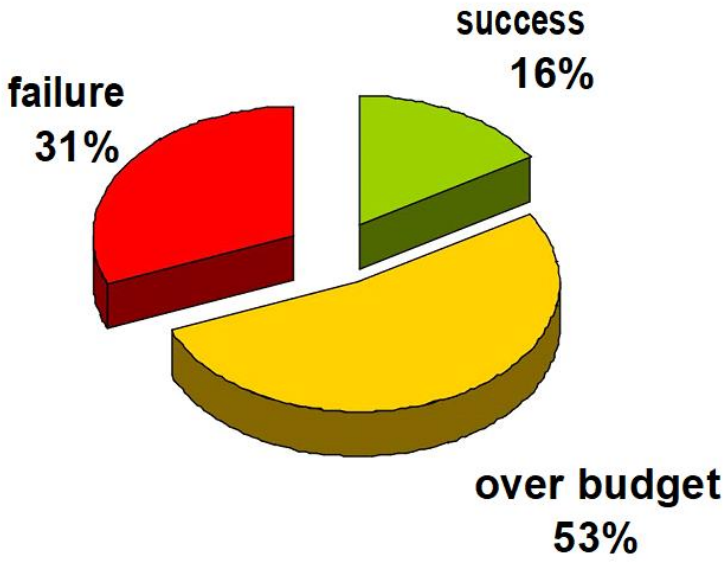
Chapter 1: Introduction to Software Engineering

- ***The Evolving Role of Software***

Software industry is in Crisis!



As per the IBM report, "31%of the project get cancelled before they are completed, 53% over-run their cost estimates by an average of 189% and for every 100 projects, there are 94 restarts".

***Managers* and *Technical Persons* are asked:**

Why does it take so long to get the program finished?

Why are costs so high?

Why can not we find all errors before release?

Why do we have difficulty in measuring progress of software development?

Factors Contributing to the Software Crisis

Larger problems,
Lack of adequate training in software engineering,
Increasing skill shortage
Low Productivity improvements

1. Some software Failures

Ariane 5

It took the European Space Agency **10 years and $7 billion** to produce Ariane 5, a giant rocket capable of hurling a pair of three-ton satellites into orbit with each launch and intended to give Europe overwhelming supremacy in the commercial space business.

The rocket was destroyed after 39 seconds of its launch, at an altitude of two and a half miles along with its payload of four expensive and uninsured scientific satellites.

Some Software

failures The Patriot Missile

First time used in Gulf war

Used as a defense from Iraqi Scud missiles

Failed several times including one that killed 28 US soldiers in Dhahran, Saudi Arabia

Reasons:

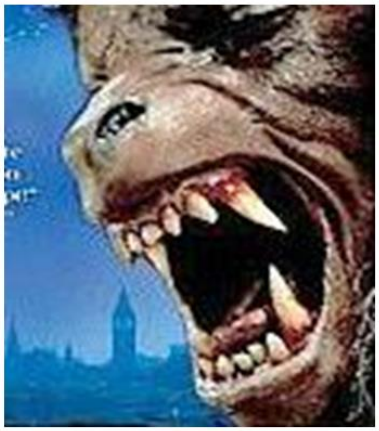
A small timing error in the system's clock accumulated to the point that after 14 hours, the tracking system was no longer accurate. In the Dhahran attack, the system had been operating for more than 100 hours.

2.No Silver Bullet

The hardware cost continues to decline drastically.

However, there are desperate cries for a silver bullet something to make software costs drop as rapidly as computer hardware costs do.

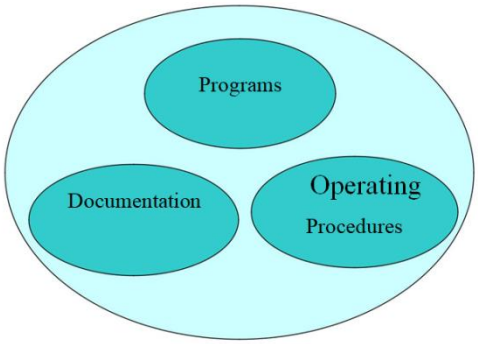
But as we look to the horizon of a decade, we see no silver bullet. There is no single development, either in technology or in management technique, that by itself promises even one order of magnitude improvement in productivity, in reliability and in simplicity.



The hard part of building software is the specification, design and testing of this conceptual construct, not the labour of representing it and testing the correctness of representation.
We still make syntax errors, to be sure, but they are trivial as compared to the conceptual errors (logic errors) in most systems. That is why, building software is always hard and there is inherently no silver bullet.
While there is no royal road, there is a path forward.
Is reusability (and open source) the new silver bullet?
The blame for software bugs belongs to:

Software companies
Software developers
Legal system
Universities

➢ What is Software?



Software=Program+Documentation+Operating Procedures

Components of software

➢ What is Software Engineering?

Software engineering is an engineering discipline which is concerned with all aspects of software production

Software engineers should

- adopt a systematic and organised approach to their work
- use appropriate tools and techniques depending on
  - the problem to be solved,
  - the development constraints and
- use the resources available

At the first conference on software engineering in 1968, Fritz Bauer defined software engineering as "The establishment and use of sound engineering principles in order to obtain economically developed software that is reliable and works efficiently on real machines".

Stephen Schach defined the same as "A discipline whose aim is the production of quality software, software that is delivered on time, within budget, and that satisfies its requirements".

Both the definitions are popular and acceptable to majority. However, due to increase in cost of maintaining software, objective is now shifting to produce quality software that is maintainable, delivered on time, within budget, and also satisfies its requirements.

➢ Software Process

The software process is the way in which we produce software.

Why is it difficult to improve software process?

Not enough time
Lack of knowledge
Wrong motivations
Insufficient commitment

➢ *Software Characteristics*

Different individuals **judge** software on different basis. This is because they are involved with the software in different ways. For example, users want the software to perform according to their requirements. Similarly, developers involved in designing, coding, and maintenance of the software evaluate the software by looking at its internal characteristics, before delivering it to the user. Software characteristics are classified into six major components.

• **Functionality:** Refers to the degree of performance of the software against its intended purpose.

Reliability: Refers to the ability of the software to provide desired functionality under the given conditions.

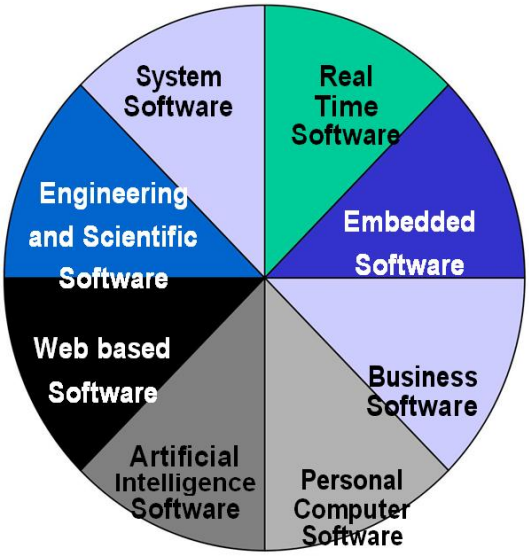
• **Usability:** Refers to the extent to which the software can be used with ease.

• **Efficiency:** Refers to the ability of the software to use system resources in the most effective and efficient manner.

• **Maintainability:** Refers to the ease with which the modifications can be made in a software system to extend its functionality, improve its performance, or correct errors.

• **Portability:** Refers to the ease with which software developers can transfer software from one platform to another, without (or with minimum) changes. In simple terms, it refers to the ability of software to function properly on different hardware and software platforms without making any changes in it.

➢ *Changing Nature of Software*



Software can be applied in countless fields such as business, education, social sector, and other fields. It is designed to suit some specific goals such as data processing, information sharing, communication, and so on. It is classified according to the range of potential of applications. These classifications are listed below.

• **System software:** This class of software manages and controls the internal operations of a computer system. It is a group of programs, which is responsible for using computer resources efficiently and effectively. For example, an operating system is a system software, which controls the hardware, manages memory and multitasking functions, and acts as an interface between application programs and the computer.

• **Real-time software:** This class of software observes, analyzes, and controls real world events as they occur. Generally, a real-time system guarantees a response to an external event within a specified period of time. An example of real-time software is the software used for weather forecasting that collects and processes parameters like temperature and humidity from the external environment to forecast the weather. Most of the defence organizations all over the world use real-time software to control their military hardware.

• **Business software:** This class of software is widely used in areas where management and control of financial activities is of utmost importance. The fundamental component of a business system comprises payroll, inventory, and accounting software that permit the user to access relevant data from the database. These activities are usually performed with the help of specialized business software that facilitates efficient framework in business operations and in management decisions.

• **Engineering and scientific software:** This class of software has emerged as a powerful tool in the research and development of next generation technology. Applications such as the study of celestial bodies, under-surface activities, and programming of an orbital path for space shuttles are heavily dependent on engineering and scientific software. This software is designed to perform precise calculations on complex numerical data that are obtained during real time environment.

• **Artificial intelligence (AI) software:** This class of software is used where the problem-solving technique is non-algorithmic in nature. The solutions of such problems are generally non-agreeable to computation or straightforward analysis. Instead, these problems require

specific problem-solving strategies that include expert system, pattern recognition, and game-playing techniques. In addition, they involve different kinds of search techniques which include the use of heuristics. The role of artificial intelligence software is to add certain degrees of intelligence to the mechanical hardware in order to get the desired work done in an agile manner.

• **Web-based software:** This class of software acts as an interface between the user and the Internet. Data on the Internet is in the form of text, audio, or video format, linked with hyperlinks. Web browser is a software that retrieves web pages from the Internet. The software incorporates executable instructions written in special scripting languages such as CGI or ASP. Apart from providing navigation on the Web, this software also supports additional features that are useful while surfing the Internet.

• **Personal computer (PC) software:** This class of software is used for both official and personal use. The personal computersoftware market has grown over in the last two decades from normal text editor to word processor and from simple paintbrush to advanced image-editing software. This software is used predominantly in almost every field, whether it is database management system, financial accounting package, or multimedia-based software. It has emerged as a versatile tool for routine applications.