Prologue

Fall, 2024

jehong@chungbuk.ac.kr

Software Working Well?

Boeing 737 Max 8 Airbus, April 2019

Boeing 737 Max 8

Software Working Well?

Microsoft & Crowdstrike glitch, July 2024

Software Working Well?

Accidents that cause loss of life and property still occur.

- Worldwide Cost of IT Failure (2013): $3trillion
- British Airways Compensation (2017) : at least £100million

Why is this loss constant?

- User requirements of software are becoming increasingly sophisticated and complex.
- The level of automation is on increasing despite services becoming more and more segmented.
- Small and large changes are frequently required in the development process.
- Characteristics of System of Systems have being appeared more and more.

→ Software developers are not handling these issues well.
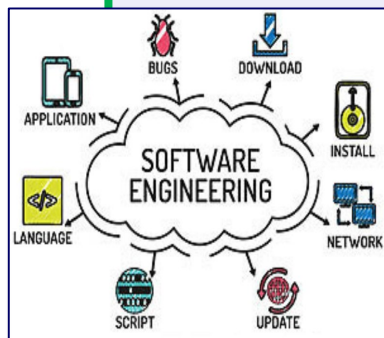
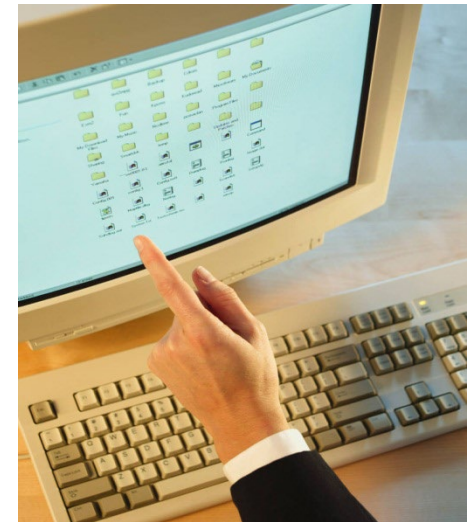# Softwae Engineering

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Software

What is Software ?

Software is a set of items or objects that form a "configuration" that includes
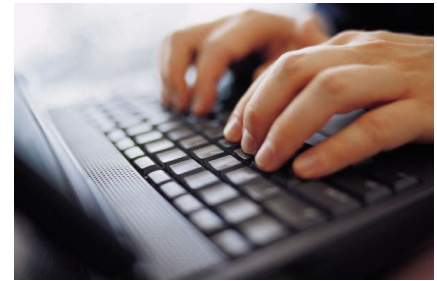
- programs
- documents
- data ...

How to Produce Software ?

Clients' Need

Writing the program code

Debugging

Any what More?

Software Crisis : Year 1968

Software Crisis

- 1968, NATO, Software Engineeing Conference
- Increased computational capacity, Increased problem complexity
  - Needs a new method for software development

Cause for the Crisis

- Increased development cost due to software scale and complexity
- Difficulty in accurately predicting software development project duration and required budget
- Lack of education and training in new technologies
- Increasing user expectations for software
- Frequent changes and reflections of user requirements for the software
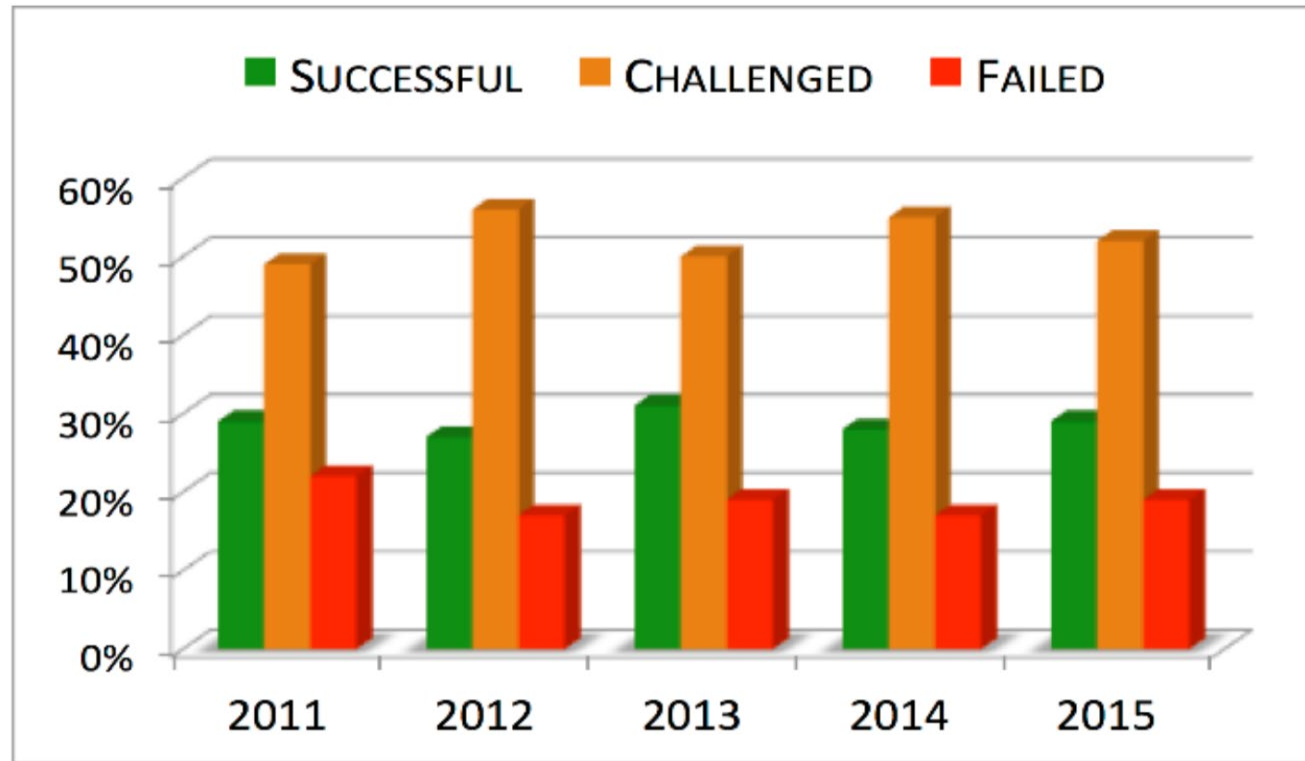
Software Crisis : Year 1980's

E 30%

A 7%

D 20%

B 8%

C 38 %
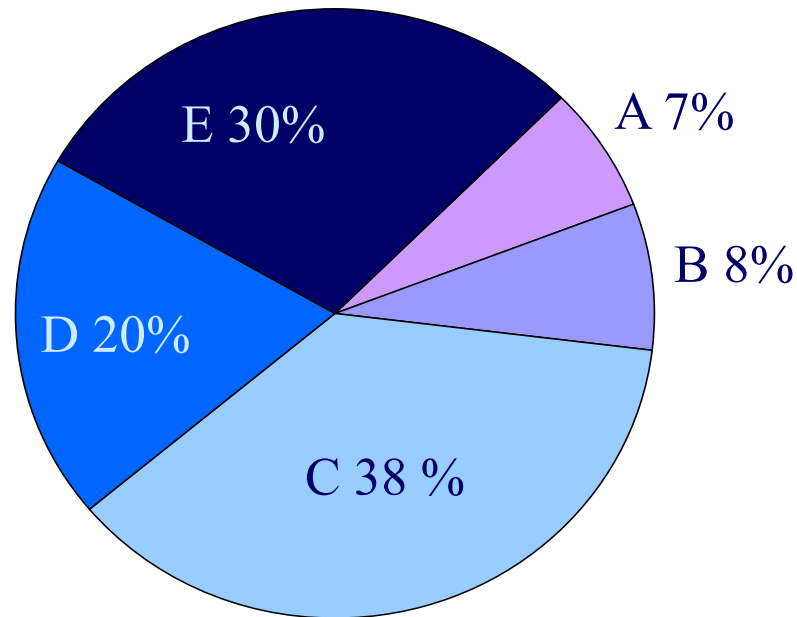
A : _____.

B : _____.

C : delivered but never successfully used

D : used but either extensively reworked or abandoned
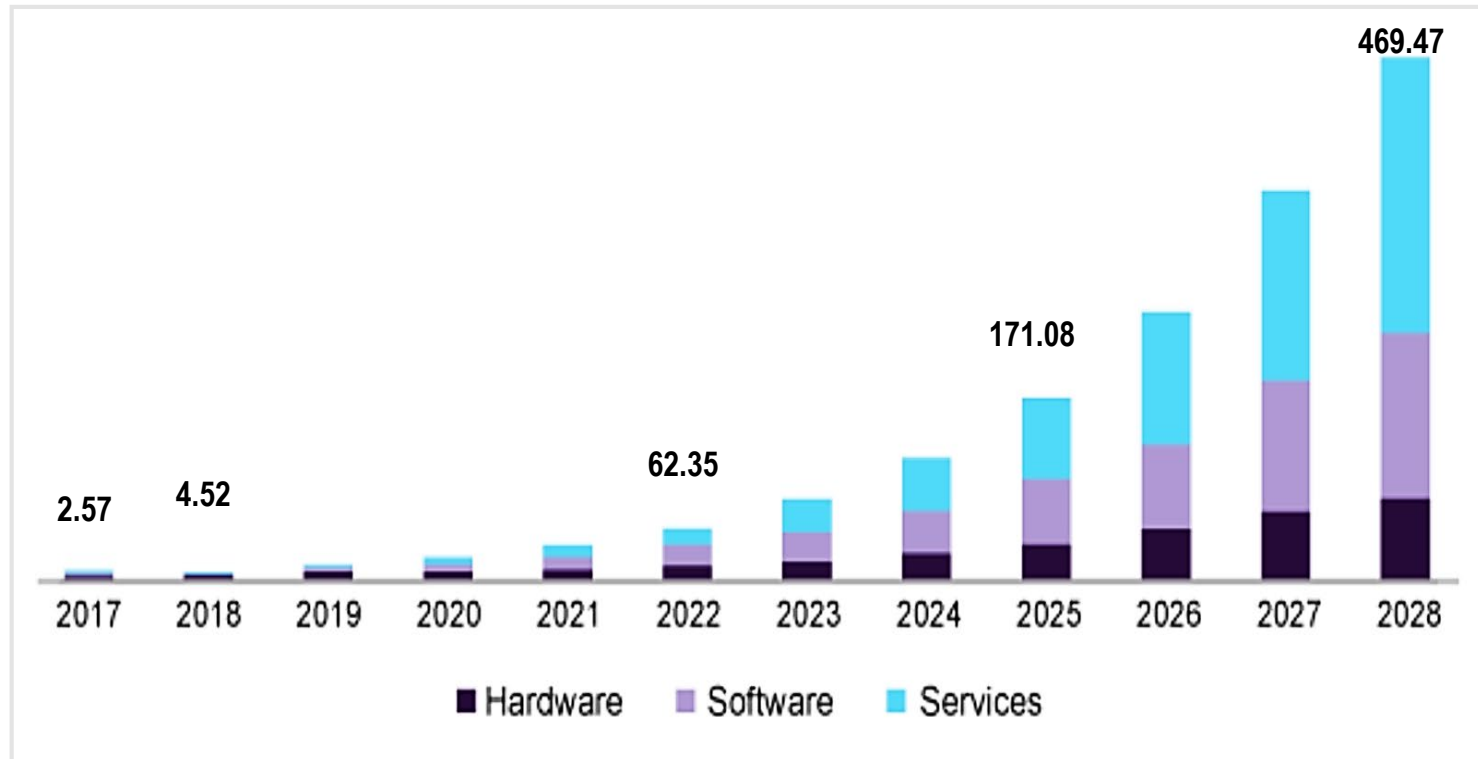
E : paid for, but never delivered

Software Crisis : Year 2010's

Standish Group, CHAOS Report, 2017, USA

The 2nd Software Crisis ?? (Year 2020's)

Asia Pacific AI Market Size (USD Billion)

Source : www.grandviewresearch.com, 2021

Why Software Development is So Difficult ?

Communications

Sequential nature of system
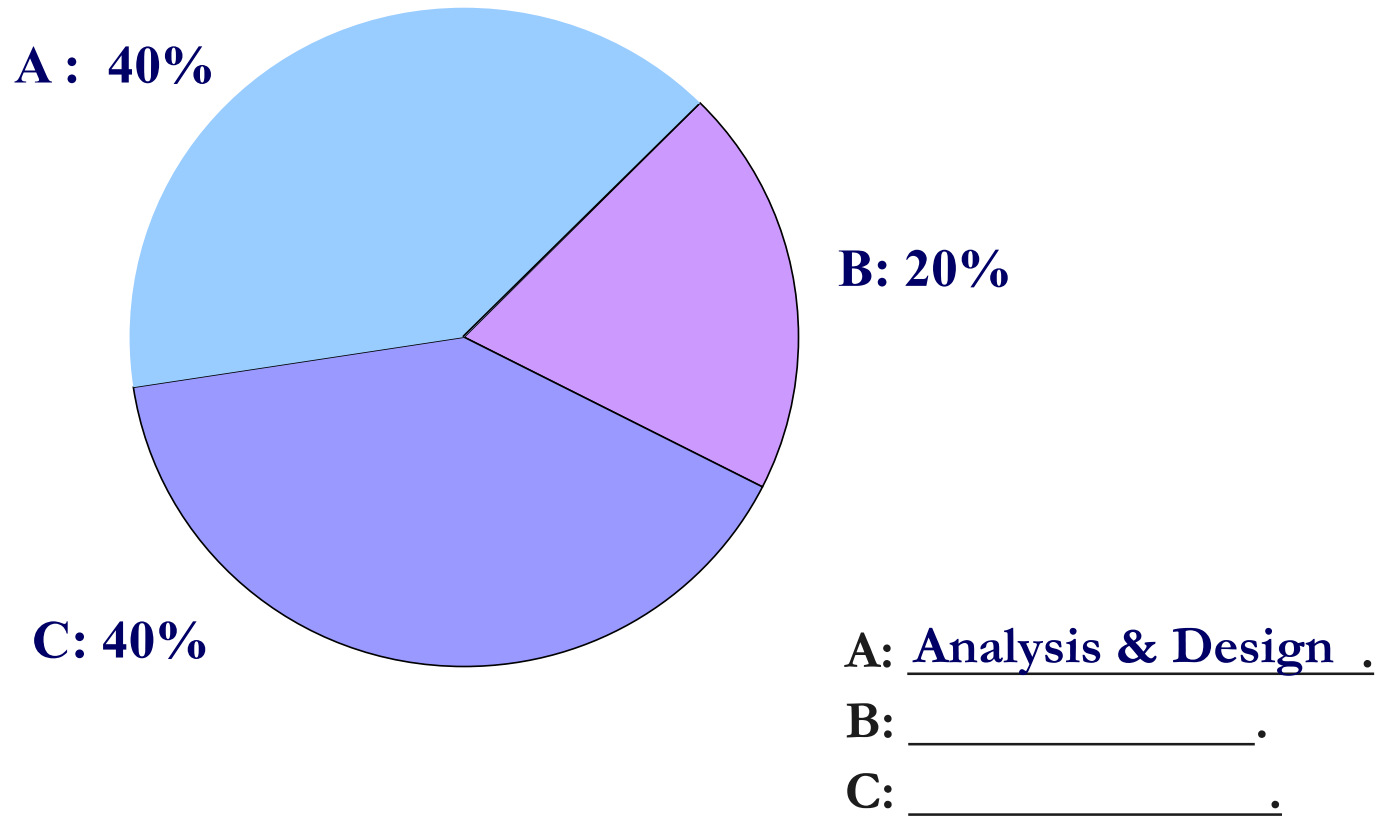
System of systems

Development

Project characteristics
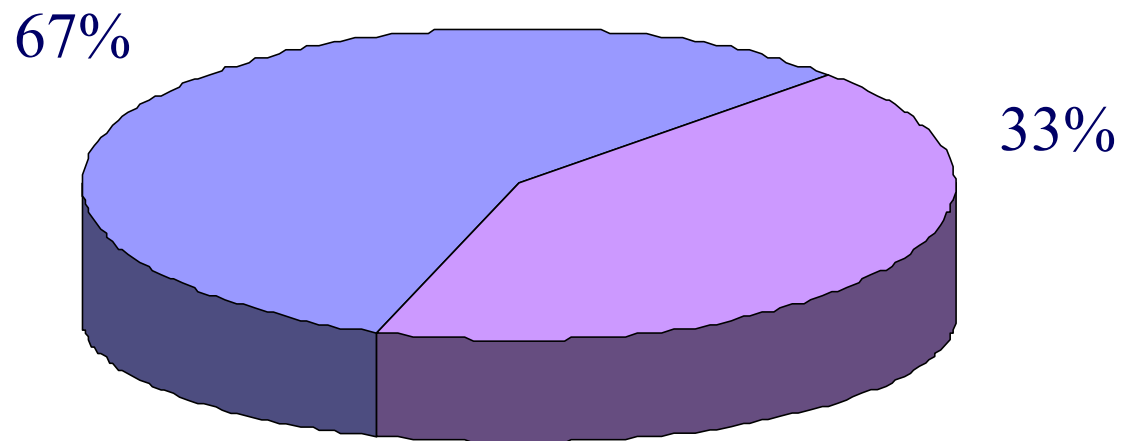
Characteristics of personnel

Management issues
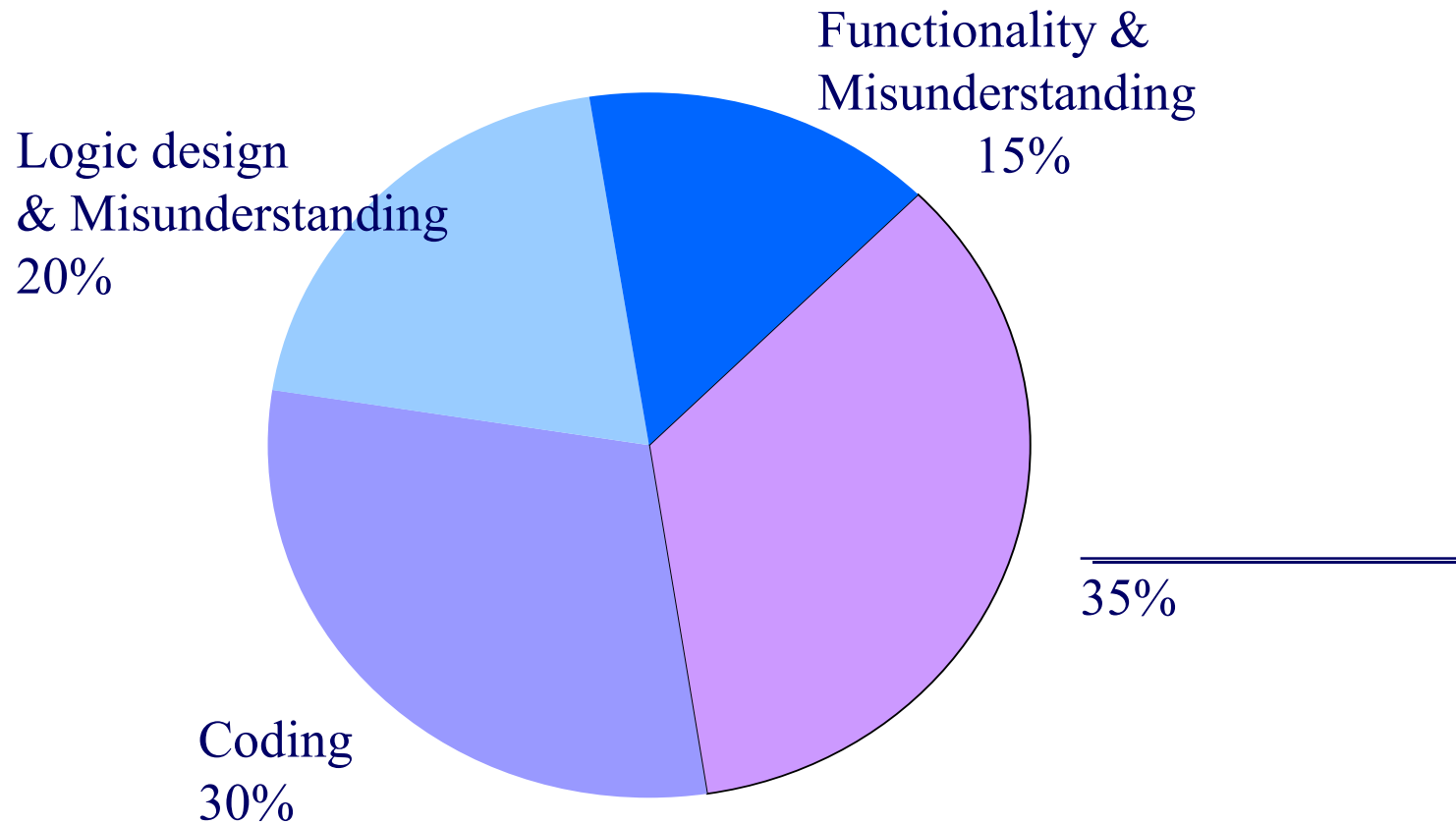
New technologies

Costs of Software Development

A : 40%

B: 20%

C: 40%

A: <u>Analysis & Design</u>.

B: _____.

C: _____.

Development vs. Maintenance

67%

33%

🟪	**Development**
🟦	**Maintenance**

Sources of Errors in Software Developments

Functionality &
Misunderstanding
15%

Logic design
& Misunderstanding
20%

35%

Coding
30%

Failure Curve

Failure Curve for Hardware

Failure rate *(y-axis)*

"Infant Mortality"

"WEAR OUT"

Time *(x-axis)*
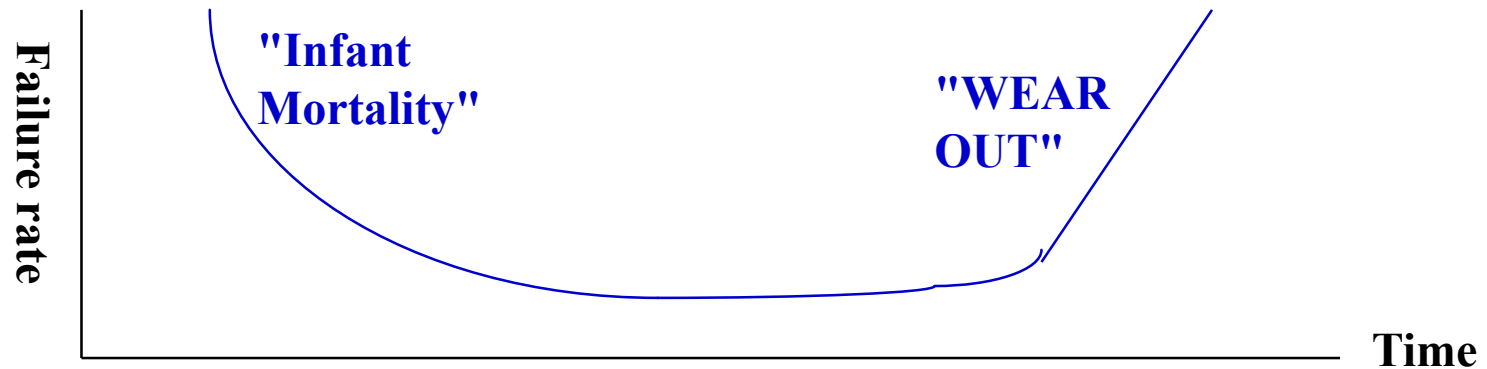
Failure Curve for Software

Failure rate *(y-axis)*

Change

Real curve ?

Ideal curve

Time *(x-axis)*
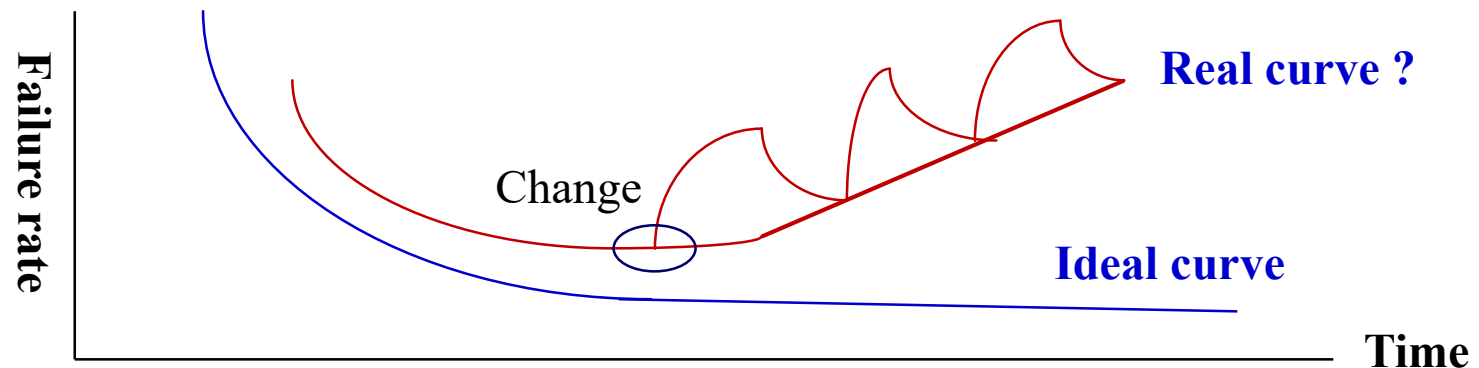
Programming Paradigm Evolution

Assembly programming → Procedure-oriented programming → Object-oriented programming → Component-Based SE → Dynamic Evolution ... Product line Engineering

What is the Goal of this Evolution ?
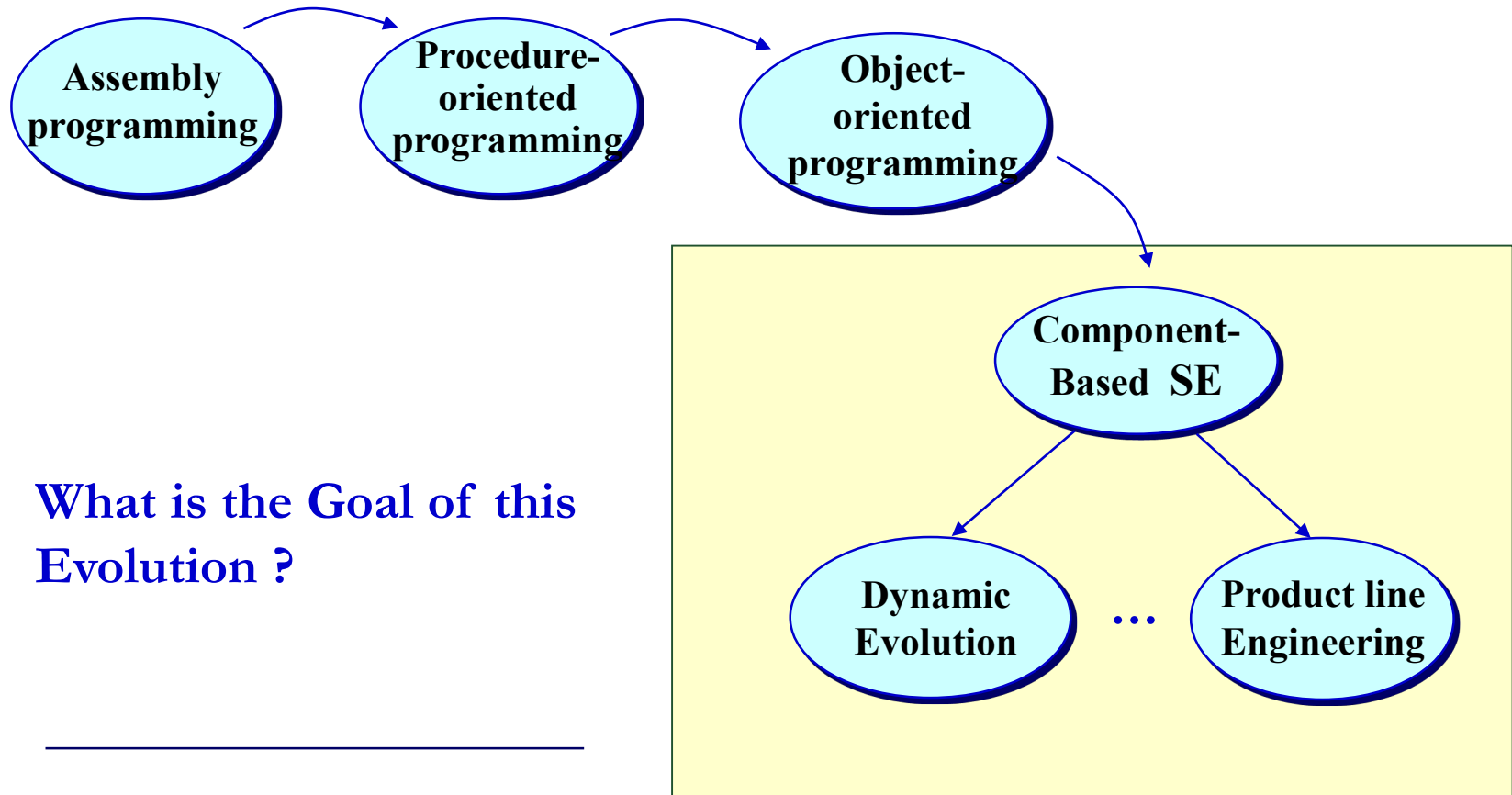
What is Software Engineering

Practical application of scientific knowledge in the design and construction of computer program and the associated documentation required to develop, operate, and maintain them. (Boehm, 1976)

Study on the principles and methodologies for developing and maintaining software systems. (Zelkowitz, 1978)

Multi-person construction of multi-version software. (Panas, 1978)

What Software Engineers do (Industri-Matematik International, 1997)

What is Software Engineering

"The application of a systematic, disciplined, quantifiable approach to the development, operation and maintenance of software" (IEEE, 1991)

What you do when you have two or more people working on a project (Inst. for Information Technology, NRC Canada, 1997)
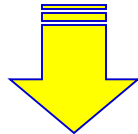
Systematic application of scientific and technological knowledge, methods, and experience to the design, implementation, testing, and documentation of software. (ISO, 24765)
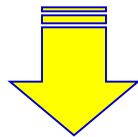
Goal of Software Engineering

Produce quality software on time within budget that satisfies user's needs
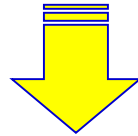
Improve quality and productivity of software

Improve quality and productivity of system, product

Summary and Discussion

Why Software So Important ?

- Every contemporary business is dependent on the capability of software