

1.1 SOFTWARE ENGINEERING CONCEPT

The Software Engineering term began to be popularized in 1968 at Software Engineering Conference that was held by NATO. Some people interpret Software Engineering to be limited on how to make a computer program. In fact, there are basic differences between software and computer program.

Software is all the command that can be used to process information. Software could take the form of the program or the procedure. The program was the collection ordered that was understood by the computer whereas the procedure was the order that was needed by the user in processing information (O'Brien, 1999). The software engineering is defined as follows:

A body of knowledge that discussed all the aspects of the production of software, starting from the early stage that is the analysis of the requirement for the user, determined the specification from the requirement for the user, the design, coding, the testing to the maintenance of the system after being used.

It is clear that Software Engineering is not only related to the production method of the computer program. The statement “all aspects of production” in the above definition, has the meaning of all the matters that are connected with the process of the production like project management, the determination of the personnel, the budget of the cost, the method, the schedule, the quality up to the training of the user was a part of Software Engineering.

1.2 SOFTWARE ENGINEERING OBJECTIVES

In general, software engineering objectives are fairly similar to other engineering fields. Let us examine Figure 1.2.

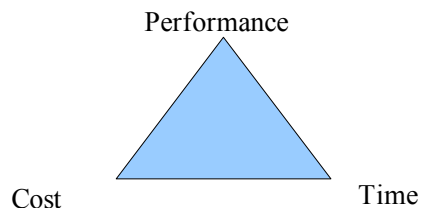


Figure 1.2. Software Engineering Objectives.

Figure 1.2 shows that an engineering field will always try to produce the highest performance output at the lowest possible cost at exact time. The software engineering aims for,

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- Lower software production cost.
- High performance and reliable software in time.
- Multi platform software.
- Low maintenance cost.

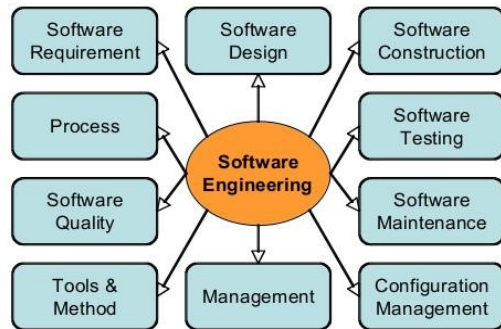


Figure 1.3. Scope of Software engineering (Abran et.al., 2004)

1.3 SCOPE

As defined above, the scope of software engineering is as follows,

- Software requirements related to the requirement specifications of the software.
- Software design includes software architecture determination, software components, interface, as well as other software characteristics.
- Software construction relates to the software development, including the algorithm, coding, testing, and debugging.
- Software testing covers software behavior evaluation and testing.
- Software maintenance Includes maintenance efforts as software is operated.
- Software configuration management is related to the configuration of software to satisfy a certain requirement.
- Software engineering management related to the management and the grating software engineering, including planning of the software project.
- Software engineering tools and methods include the theoretical study on aids and the software engineering method.
- Software engineering process is concerned with the definition, the implementation, the grating, the management, the change and the improvement of the process software engineering.
- Software quality is stressed on the quality and the software life-cycle.

1.4 SOFTWARE ENGINEERING AND COMPUTER SCIENCE

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Computer Science was born at the beginning of the 1940 's that was the integration from the theory of the algorithm, mathematical logic and the discovery of the storage method of the program electronically to the computer. Since then computer science had experienced continuous development and broadening.

The scope of knowledge in computer science often described as a systematic study in processes of the algorithm that explained and transformed information (Denning, 2000). It includes the theory, the analysis, the design, efficiency, the application and it application.

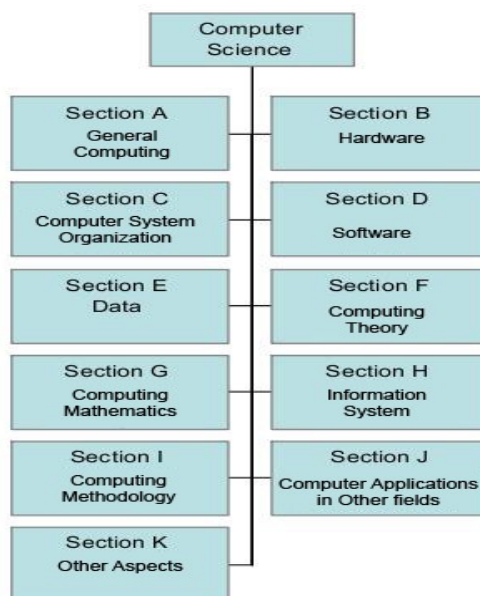


Figure 1.4. Computer Science Classification based on ACM (1998).

There are several branch of knowledge in the computer science discipline as seen in the Figure 1.4, 1.5 and 1.6.

Based on Denning's (2000) and Wikipedia's (2007), software engineering was the subsector of computer science that was equal to the other subsector. Whereas according to ACM (Association for Computing Machinery), software engineering is part of Section D (Software). Although being seen separated, in its application, the subsector software engineering always needed the support from the other subsector, especially algorithm and data structure, programming language, database, operating system and network, and information system.

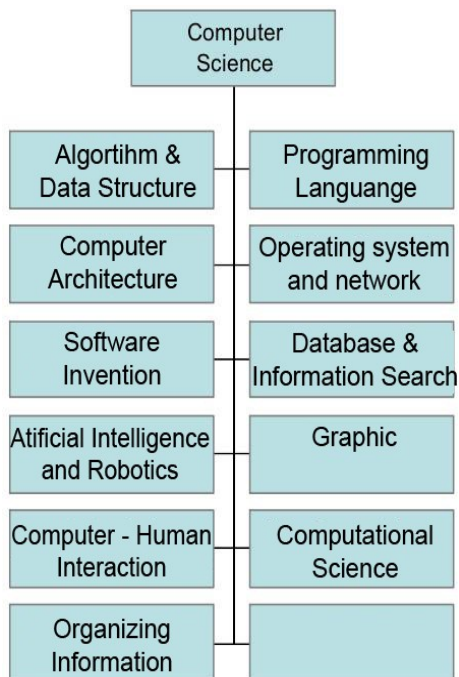


Figure 1.5. Computer Science Classification Discipline based on Denning (2000).

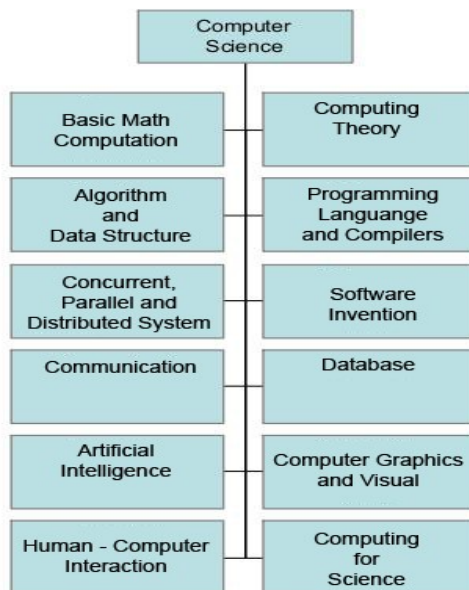
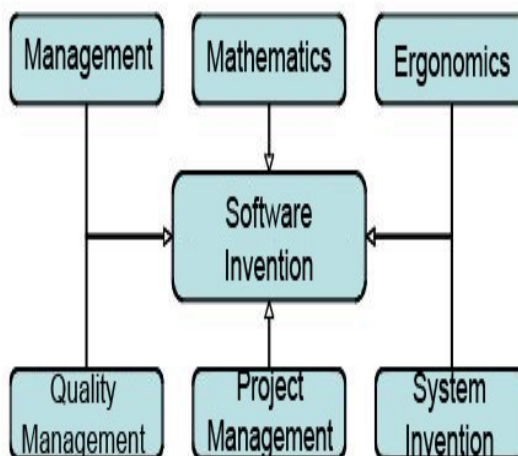


Figure 1.6. Computer Science discipline based on Wikipedia (2007).

1.5 SOFTWARE ENGINEERING AND OTHER DISCIPLINE

Since the scope of software engineering is quite wide, it relies heavily to other fields.

Not only with other sub sector in computer science but also other fields outside computer science. Software engineering relations with other fields can be seen in Figure 1.7.



Picture 1.7. Software Engineering relations with other fields

- Management field covers accounting, financial, marketing, operation management, economics, quantitative analysis, human resources management, policy and business strategy.
- mathematical field covers linear algebra, calculus, probabilistic, statistics, numerical analysis and discrete mathematics.
- Project management field covers project related matters, such as, project scope, budgeting, human resource, quality control, risk management, and project scheduling.
- Quality management field covers quality system development, risk and reliability management, quality improvement, and quantitative methods.
- Ergonomics field covers man and machine interaction.
- System engineering covers system theory, cost analysis, modeling, simulation, business process and operation.

1.6 SOFTWARE ENGINEERING DEVELOPMENT

Despite its early appearance in 1968, software engineering had the quite long history. Figure 1.8 presented the essence of the software engineering development. From the science side of discipline of knowledge, software engineering is relatively young and is continue to develop. Today, the direction of the development is as follows,

Agile Software Development, Experimental Software Development, Model-Driven Software Development and Software Product Lines.

Year	Event
1940	The first computer that allowed user to write the program code directly.
1950	Early generation of interpreter and macro language
	First generation of compilers
	Second generation of compilers
1960	Commercialization of mainframe computers
	The development customized software
	Software engineering concepts is being adopted
1970	Software development applications
	Commercialization of minicomputers
1980	Commercialization of personal computers
	Increase in software demand
	Object Oriented Programming (OOP)
1990	Agile process and extreme programming

	Drastic increase in memory capacity
	Increase in Internet users
2000	Modern interpreter platform (Java, .Net, PHP, etc).
	Outsourcing

Figure 1.8. Software Engineering Development

1.7 PROFESSION AND CERTIFICATION

Software Engineer profession is fairly new for Indonesians. Most Indonesians possibly more familiar with the term Information Technology expert, Information System Analyst, Operator or the other term. It is due to the confusion on the term software engineer as described in the early of the chapter. However in countries with mature information technology, Software Engineer term is more often used.

Software engineer certification is still debatable among expert and software vendor. Most certification in software industry is usually product specific. For example, the software company like Redhat Linux Inc., Adobe Inc., Oracle, or Microsoft, give certification to those who master their product.

ACM (Association for Computing Machinery) had run Software Engineer certification program in the 1980. Unfortunately, they have to discontinue due to lack of interest. IEEE (Institute of Electrical and Electronics Engineers) has Issued more than 500 certificates of software profession. Canada has issued a legal certificate for software engineer that was known as ISP (Information Systems Professional).

At this time, there is no software engineer certification in Indonesia. However, the National Competence for Computer Programmer has been defined. Although, it has not fully covered computer programmer field, it can be used for early approach to software engineer certification.

1.8 SOFTWARE ENGINEERING AND PROBLEM SOLVING

Software engineering had conceptually close to problem solving principles. Understanding on the problems, the strategy and the process as well as the system approach in the solution to the problem will help the software engineering processes.

1.8.1 The Problem and The Symptom

A problem can be seen as the difference between the condition that happened and the condition that it was hoped. It might also be interpreted as the difference between the condition now and the aimed condition. For example, a student hoped to receive 80 in a C++ Programming exam, but in fact he only received 60. The existence of this difference showed the existence of a problem.

Often it is difficult to distinguish between the symptom and the problem. The symptom is a sign of the occurrence of a problem. Pay attention to a person who is a medical doctor professional as shown in Figure 1.9. A doctor in treating the patient's illness will ask the symptom / the signs that were felt by the patient.



Figure 1.9. Medical Doctor Profession

What is the relationship between problem and symptom with Software Engineering? As being said earlier in the chapter, software that was results of Software Engineering to create an air to complete certain task or to solve certain problem. If we did not learn correctly the problem, it is impossible to determine how solve it. Thus, knowing well the problem as well as knowledge on the symptom of the problem would be very important.

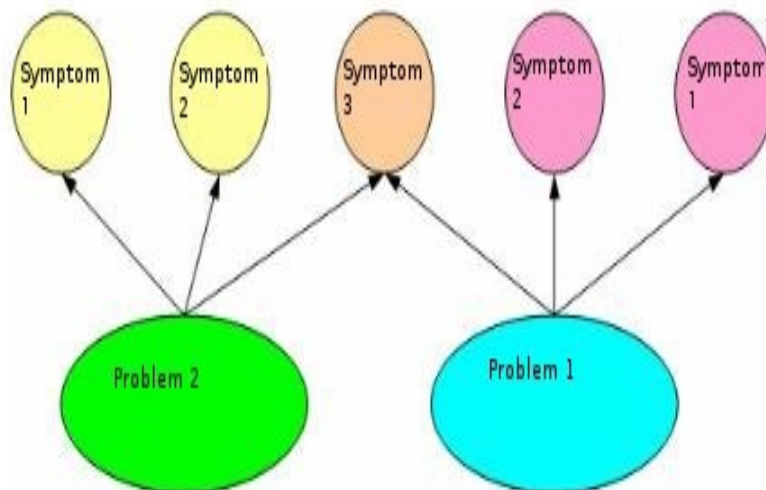


Figure 1.10. Symptom and Problem.

1.8.2. Type of Problem

Problem can be classified as shown in Figure 1.11.

- Problem in standard fulfillment. The problem in this group is related to the achievement of the standard that was determined in an organization. It usually relates to the long term objectives of the organization.

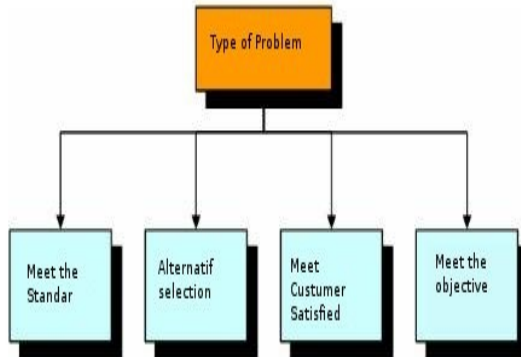


Figure 1.11.Type of Problem (Deek et.al., 2005)

- Problem in alternative selection. The problem in this group is in choosing the best solution from various alternatives based on certain criteria. This problem is often encountered in daily life, such as, choose the exact school, choose the residence location, choose field of work. The alternative and the criterion had the weight that was agreed to.
- Problem in customer's satisfaction fulfillment. In profit oriented organizations, problem in customer's satisfaction fulfillment is often emerged. The customers may have many wishes and one may be highly different than others. Fulfill all customer's wishes may not possible and very incriminating an organization. One must look for the solution that benefit both the customer and the organization.
- The problem in goal achievement. This type of problem resembles the first type of problem, problem in standard fulfillment. The difference, this type of problem is in achieving short term goals that might not be fixed can be altered in a short time.

1.8.3. Problem Solving

Problem solving is a process where a situation was observed and after the problem found, a solution is made by determining the problem, reducing or eliminating the problem or preventing the problem from happening. There were many steps of problem solving proposed by the experts, one of them can be seen in the Figure 1.12.

Figure 1.12 shows a series of different process stage that could be used in various stages, depended on the type and the characteristics of the problem. Different problem may need different method, even possibly the different stages. The critical stage in problem solving is in defining the problem. If the problem not clearly defined then the stages may be along and difficult to undertake. Moreover if it being forced, problem solution may not likely be found.

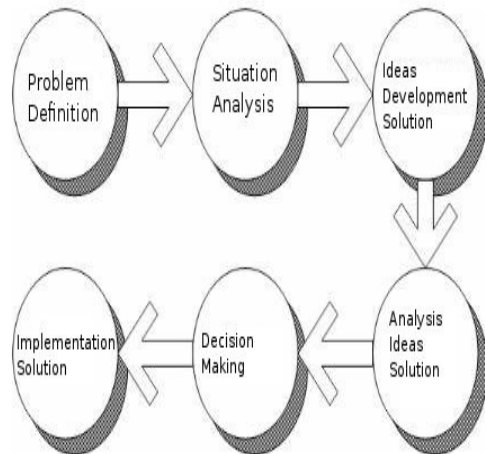


Figure 1.12. Problem Solving Processes (adopted from Deek et.al., 2005)

In general, problem solving may be carried out in four (4) main stages, namely,

- Understand and defining the problem. This stage is critical and the starting point of any problem solving processes. The aim of this stage is to get clear picture of the problem as well as to eliminate unimportant sections.
- Planning for problem solving. This stage is normally split into two (2) main section, namely,
 1. Looking for various ways to solve the problem.
 2. Planning to solve the problem.

There may be not one but several solutions to a problem. As an illustration, if we were in Surabaya and wanted to go to Jakarta, there are several options that can be used either by land, sea or air transportation. Over land transportation, train, bus or other transportation can be used. We can use the north, middle or south route. Thus, plenty of solutions can be used by us. Each has its own characteristics. However, we must choose one that meet certain conditions that would be best for our problem. After being chosen, then we could make the plan for problem solving and divide the problem into smaller parts. The rough plan for problem solving should only contain the main stages of problem solving.

- Draft and apply the plan to get the appropriate solution. In this stage, the rough plan is refined and clarified into details of more complete of problem solving plan.

- Check and provide results of the problem solving. The purpose of this stage is to check the resulting accuracy of the chosen method whether fulfill the objectives. Moreover, we can evaluate the chosen method usefulness.

1.9.SUMMARY

- **Software** is the command / tool that can be used to process information.
 1. **A program** is a collection of command that can be understood by computer.
 2. **A procedure** is the command needed by the users in information processing.
- Software Engineering is a body of knowledge that discuss all aspects of software production, starting from the early stage, namely, analysis of user requirement, determined the user requirement specification, design, coding, testing up to system maintenance after being used.
- The objective of Software Engineering is to produce high performance and high quality software, right on time, at low cost, and the multi-platform.
- Software Engineering is part of computer science that require support from other field of computer science as well as other field of knowledge.
- Software Engineering Certification is not readily available. However, other programmer certification be used.
- **A problem** can be seen as the difference between the condition that happened and the condition that it was hoped. **A Symptom** is the sign of problem.
- Type of problem:
 1. Problem in standard fulfillment.
 2. Problem in alternative selection.
 3. Problem in customer's satisfaction fulfillment.
 4. The problem in goal achievement.
- **Problem solving** is a process where a situation was observed and after the problem found, a solution is made by determining the problem, reducing or eliminating the problem or preventing the problem from happening.
- Main stages in problem solving:
 1. Understand and defining the problem.
 2. Planning for problem solving.
 3. Draft and apply the plan to get the appropriate solution.
 4. Check and provide results of the problem solving.

1.10. EXERCISE

1. Describe software and software engineering.
2. What are the difference between the computer program and the procedure?
3. Name five sub-field of computer science based based on Denning's.
4. Name five field that closely related to software engineering.
5. Describe symptom and problem?